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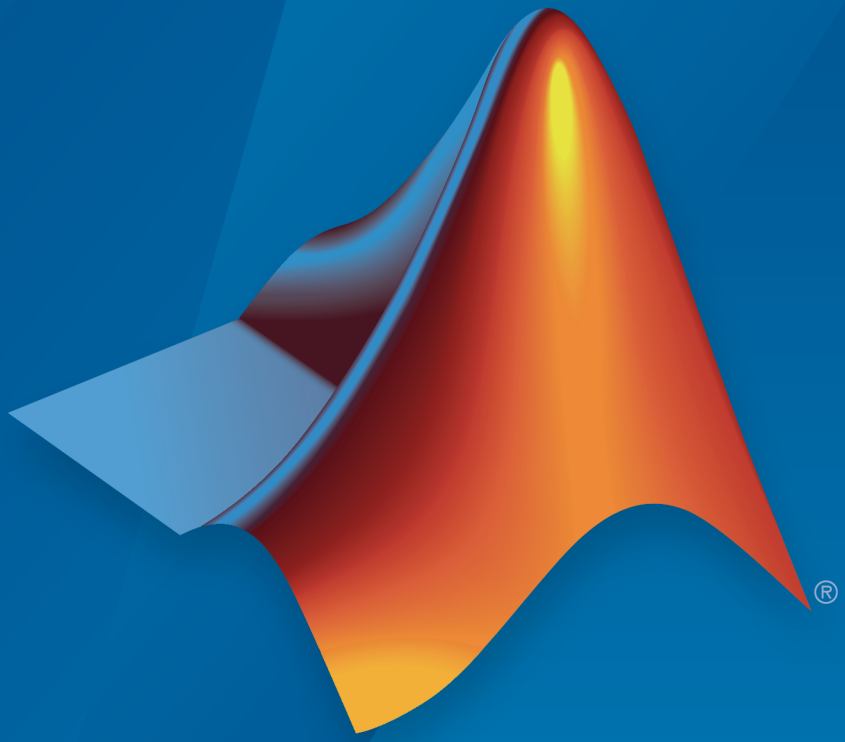
Spark™ Integration



MATLAB®

R2016b

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MATLAB® Compiler™ Spark™ Integration

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Classes — MATLAB API for Spark

matlab.compiler.mlspark.RDD class

Package: matlab.compiler.mlspark

Interface class to represent a Spark Resilient Distributed Dataset (RDD)

Description

A *Resilient Distributed Dataset* or *RDD* is a programming abstraction in Spark™. It represents a collection of elements distributed across many nodes that can be operated in parallel. All work in Spark is expressed as either creating new RDDs, transforming existing RDDs, or calling operations on RDDs to compute a result. You can create RDDs in two ways:

- By loading an external dataset
- By parallelizing a collection of objects in the *driver* on page 4-6 program

Once created, two types of operations can be performed using RDDs: *transformations* and *actions*.

Construction

An `RDD` object can only be created using the methods of the `SparkContext` class. A collection of `SparkContext` methods used to create RDDs is listed below for convenience. See the documentation of the `SparkContext` on page 1-13 class for more information.

SparkContext Method Name	Purpose
`parallelize` on page 3-12	Create an RDD from local MATLAB® values
`datastoreToRDD` on page 3-8	Convert MATLAB `datastore` to a Spark `RDD`
`textFile` on page 3-18	Create an RDD from a text file

Once an RDD has been created using a method from the `SparkContext` class, you can use any of the methods in the `RDD` class to manipulate your RDD.

Properties

The properties of this class are hidden.

Methods

Transformations

Actions

Operations

Definitions

A *Resilient Distributed Dataset* or *RDD* is a programming abstraction in Spark. It represents a collection of elements distributed across many nodes that can be operated in parallel. RDDs tend to be fault-tolerant. You can create RDDs in two ways:

- By loading an external dataset.
- By parallelizing a collection of objects in the *driver* on page 4-6 program.

After creation, you can perform two types of operations using RDDs: *transformations* and *actions*.

Transformations are operations on an existing RDD that return a new RDD. Many, but not all, transformations are elementwise operations.

Actions compute a final result based on an RDD and either return that result to the driver program or save it to an external storage system such as HDFS™.

References

See the latest Spark documentation for more information.

See Also

Classes

matlab.compiler.mlspark.SparkConf | matlab.compiler.mlspark.SparkContext

Related Examples

- “Example on Deploying Applications to Spark Using the MATLAB API for Spark” on page 7-2

More About

- “Apache Spark Basics” on page 4-2

Introduced in R2016b

matlab.compiler.mlspark.SparkConf class

Package: matlab.compiler.mlspark

Interface class to configure an application with Spark parameters as key-value pairs

Description

A `SparkConf` object stores the configuration parameters of the application being deployed to Spark. Every application needs to be configured prior to deployment on a Spark cluster. The configuration parameters are passed onto a Spark cluster through a `SparkContext`.

Construction

`conf = matlab.compiler.mlspark.SparkConf('AppName',name,'Master',url,'SparkProperties',prop)` creates a `SparkConf` object with the specified configuration parameters.

`conf = matlab.compiler.mlspark.SparkConf(___,Name,Value)` creates a `SparkConf` object with additional configuration parameters specified by one or more Name,Value pair arguments. `Name` is a property name of the class and `Value` is the corresponding value. `Name` must appear inside single quotes (`''`). You can specify several name-value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Input Arguments

`name` — Name of the MATLAB application deployed to Spark

character vector

Name of application specified as a character vector inside single quotes (`''`).

Example: `'AppName', 'myApp'`

Data Types: `char`

`url` — Master URL to connect to

character vector

Name of the master URL specified as a character vector inside single quotes (' ').

URL	Description
`local`	Run Spark locally with one worker thread. There is no parallelism by selecting this option.
`local[K]`	Run Spark locally with K worker threads. Set K to the number of cores on your machine.
`local[*]`	Run Spark locally with as many worker threads as logical cores on your machine.
`yarn-client`	Connect to a Hadoop® YARN cluster in client mode. The cluster location will be found based on the `HADOOP_CONF_DIR` or `YARN_CONF_DIR` variable.

Example: `'Master', 'yarn-client'`

Data Types: `char`

`prop` — Map of key-value pairs that specify Spark configuration properties
`containers.Map` object

A `containers.Map` object containing Spark configuration properties as key-value pairs.

Note: When deploying to a local cluster using the MATLAB API for Spark, the `'SparkProperties'` property name can be completely ignored during the construction of a `SparkConf` object, thereby requiring no value for `prop`. Or you can set `prop` to an empty `containers.Map` object as follows:

```
'SparkProperties',containers.Map({''},{''})
```

The key and value of the `containers.Map` object are empty `char` vectors.

When deploying to a Hadoop YARN cluster, set the value for `prop` with the appropriate Spark configuration properties as key-value pairs. The precise set of Spark configuration properties vary from one deployment scenario to another, based on the deployment cluster environment. Users must verify the Spark setup with a system administrator to use the appropriate configuration properties. See the table for commonly used Spark properties. For a full set of properties, see the latest Spark documentation.

Running Spark on YARN

Property Name (Key)	Default (Value)	Description
`spark.executor.cores`	1	The number of cores to use on each executor. For YARN and Spark standalone mode only. In Spark standalone mode, setting this parameter allows an application to run multiple executors on the same worker, provided that there are enough cores on that worker. Otherwise, only one executor per application runs on each worker.
`spark.executor.instanc`	2	The number of executors. **Note:** This property is incompatible with `spark.dynamicAllocation.enabled`. If both `spark.dynamicAllocation.enabled` a specified, dynamic allocation is turned off and the specified number of `spark.executor.instance`s is used.
`spark.yarn.executor.me`	`executorMemory * 0.10`, with minimum of 384	The amount of off-heap memory (in MBs) to be allocated per executor.
`spark.dynamicAllocatio`	`false`	This option integrates Spark with the YARN resource management. Spark initiates as many executors as possible given the executor memory requirement and number of cores. This

Property Name (Key)	Default (Value)	Description
		property requires that the cluster be set up. Setting this property to `true` specifies whether to use dynamic resource allocation, which scales the number of executors registered with this application up and down based on the workload. This property requires `spark.shuffle.service.enabled` to be set. The following configurations are also relevant: `spark.dynamicAllocation.minExecu` `spark.dynamicAllocation.maxExecu` and `spark.dynamicAllocation.initialE`
`spark.shuffle.service.`	`false`	Enables the external shuffle service. This service preserves the shuffle files written by executors so the executors can be safely removed. This must be enabled if `spark.dynamicAllocation.enabled` i set to `true`. The external shuffle service must be set up in order to enable it.

MATLAB Specific Properties

Property Name (Key)	Default (Value)	Description
`spark.matlab.worker.del`	`false`	For use in standalone/ interactive mode only. If set to true, a Spark

Property Name (Key)	Default (Value)	Description
		deployable MATLAB application executed within the MATLAB desktop environment, launches another MATLAB session as worker, and will enter the debugger. Logging information is directed to `log_<nbr>.txt`.
`spark.matlab.worker.re`	`true`	When set to `true`, a Spark executor pools workers and reuses them from one stage to the next. Workers terminate when the executor under which the workers are running terminates.
`spark.matlab.worker.pr`	`false`	Only valid when using a session of MATLAB as a worker. When set to `true`, it turns on the MATLAB Profiler and generates a Profile report that is saved to the file `profworker_<split_index>_<socket pass>.mat`.
`spark.matlab.worker.nu`	`10000`	Number of unique keys that can be held in a `containers.Map` object while performing `*ByKey` operations before map data is spilled to a file.

Monitoring and Logging

Property Name (Key)	Default (Value)	Description
`spark.history.fs.logDi`	`file:/tmp/spark-events`	Directory that contains application event logs to be loaded by the history server.
`spark.eventLog.dir`	`file:///tmp/spark-events`	Base directory in which Spark events are logged, if `spark.eventLog.enabled` is `true`. Within this base directory, Spark creates a sub directory for each application, and logs the events specific to the application in this directory. You can set this to a unified location like an HDFS directory so history files can be read by the history server.
`spark.eventLog.enabled`	`false`	Whether to log Spark events This is useful for reconstructing the web UI after the application has finished.

Data Types: `char`

Name-Value Pair Arguments

Specify optional comma-separated pairs of `Name,Value` arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside single quotes (`' '`). You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

`'ExecutorEnv'` — Map of key-value pairs that will be used to establish the executor environment

`containers.Map` object

Map of key-value pairs specified as a `containers.Map` object.

Example: `'ExecutorEnv', containers.Map({'SPARK_JAVA_OPTS'}, {'-Djava.library.path=/my/custom/path'})`

`'MCRRoot'` — Path to MATLAB Runtime that is used to execute driver application

character vector

A character vector specifying the path to MATLAB Runtime within single quotes `''`.

Example: `'MCRRoot', '/share/MATLAB/MATLAB_Runtime/v91'`

Data Types: `char`

Properties

The properties of this class are hidden.

Methods

There are no user executable methods for this class.

Definitions

SparkConf stores the configuration parameters of the application being deployed to Spark. Every application needs to be configured prior to being deployed on a Spark cluster. Some of the configuration parameters define properties of the application and some are used by Spark to allocate resources on the cluster. The configuration parameters are passed onto a Spark cluster through a `SparkContext`.

Examples

Configure an Application With Spark Parameters

The `SparkConf` class allows you to configure an application with Spark parameters as key-value pairs.

```
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
```

- “Example on Deploying Applications to Spark Using the MATLAB API for Spark” on page 7-2

References

See the latest Spark documentation for more information.

See Also

Classes

matlab.compiler.mlspark.SparkContext | matlab.compiler.mlspark.RDD

More About

- “Apache Spark Basics” on page 4-2

Introduced in R2016b

matlab.compiler.mlspark.SparkContext class

Package: matlab.compiler.mlspark

Interface class to initialize a connection to a Spark enabled cluster

Description

A `SparkContext` object serves as an entry point to Spark by initializing a connection to a Spark cluster. It accepts a `SparkConf` object as an input argument and uses the parameters specified in that object to set up the internal services necessary to establish a connection to the Spark execution environment.

Construction

`sc = matlab.compiler.mlspark.SparkContext(conf)` creates a `SparkContext` object initializes a connection to a Spark cluster.

Input Arguments

`conf` — Variable name representing a `SparkConf` object

`SparkConf` object

Pass the `SparkConf` object as input to the `SparkContext`.

Example: `sc = matlab.compiler.mlspark.SparkContext(conf);`

See matlab.compiler.mlspark.SparkConf for information on how to create a `SparkConf` object.

Properties

The properties of this class are hidden.

Methods

Definitions

A *SparkContext* represents a connection to a Spark cluster. It is the entry point to Spark and sets up the internal services necessary to establish a connection to the Spark execution environment.

Examples

Initialize a Connection to a Spark Enabled Cluster

The `SparkContext` class initializes a connection to a Spark enabled cluster using Spark properties.

```
% Setup Spark Properties as a containers.Map object
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});

% Create SparkConf object
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
% Create a SparkContext
sc = matlab.compiler.mlspark.SparkContext(conf);
```

- “Example on Deploying Applications to Spark Using the MATLAB API for Spark” on page 7-2

References

See the latest Spark documentation for more information.

See Also

Classes

matlab.compiler.mlspark.SparkConf | matlab.compiler.mlspark.RDD

More About

- “Apache Spark Basics” on page 4-2

Introduced in R2016b

matlab.mapreduce.DeploySparkMapReducer class

Package: matlab.mapreduce

Configure a MATLAB tall array application with Spark parameters as key-value pairs

Description

A `DeploySparkMapReducer` object stores the configuration parameters of the tall array application being deployed to Spark. Every tall array application needs to be configured prior to being deployed on a Spark cluster. Some of the configuration parameters define properties of the application and some are used by Spark to allocate resources on the cluster. The configuration parameters are passed onto a Spark cluster through a `mapreducer` function.

Construction

`conf = matlab.mapreduce.DeploySparkMapReducer('AppName', name,'Master',url,'SparkProperties',prop)` creates a `DeploySparkMapReducer` object with the specified configuration parameters.

`conf = matlab.mapreduce.DeploySparkMapReducer('AppName', name,'Master',url,'SparkProperties',prop,Name,Value)` creates a `DeploySparkMapReducer` object with additional configuration parameters specified by one or more Name,Value pair arguments. `Name` is a property name of the class and `Value` is the corresponding value. `Name` must appear inside single quotes (`''`). You can specify several name-value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Input Arguments

`name` — Name of the MATLAB application deployed to Spark

character vector

Name of application specified as a character vector inside single quotes (`''`).

Example: `'AppName', 'myApp'`

Data Types: `char`

`url` — Master URL to connect to

character vector

Name of the master URL specified as a character vector inside single quotes (`' '`).

URL	Description
`yarn-client`	Connect to a Hadoop YARN cluster in client mode. The cluster location will be found based on the `HADOOP_CONF_DIR` or `YARN_CONF_DIR` variable.

Example: `'Master', 'yarn-client'`

Data Types: `char`

`prop` — Map of key-value pairs that specify Spark configuration properties

`containers.Map` object

A `containers.Map` object containing Spark configuration properties as key-value pairs.

When deploying to a Hadoop YARN cluster, set the value for `prop` with the appropriate Spark configuration properties as key-value pairs. The precise set of Spark configuration properties vary from one deployment scenario to another, based on the deployment cluster environment. Users must verify the Spark setup with a system administrator to use the appropriate configuration properties. See the table for commonly used Spark properties. For a full set of properties, see the latest Spark documentation.

Running Spark on YARN

Property Name (Key)	Default (Value)	Description
`spark.executor.cores`	1	The number of cores to use on each executor. For YARN and Spark standalone mode only. In Spark standalone mode, setting this parameter allows an application to run multiple executors on the same worker, provided that there are enough cores on that worker. Otherwise, only

Property Name (Key)	Default (Value)	Description
		one executor per application runs on each worker.
spark.executor.instanc	2	The number of executors. **Note:** This property is incompatible with spark.dynamicAllocation.enabled. If both spark.dynamicAllocation.enabled a specified, dynamic allocation is turned off and the specified number of spark.executor.instances is used.
spark.yarn.executor.mer	executorMemory * 0.10, with minimum of 384	The amount of off-heap memory (in MBs) to be allocated per executor.
spark.dynamicAllocatio	false	This option integrates Spark with the YARN resource management. Spark initiates as many executors as possible given the executor memory requirement and number of cores. This property requires that the cluster be set up. Setting this property to true specifies whether to use dynamic resource allocation, which scales the number of executors registered with this application up and down based on the workload. This property requires spark.shuffle.service.enabled

Property Name (Key)	Default (Value)	Description
		to be set. The following configurations are also relevant: `spark.dynamicAllocation.minExecu` `spark.dynamicAllocation.maxExecu` and `spark.dynamicAllocation.initialE`
`spark.shuffle.service.`	`false`	Enables the external shuffle service. This service preserves the shuffle files written by executors so the executors can be safely removed. This must be enabled if `spark.dynamicAllocation.enabled` i set to `true`. The external shuffle service must be set up in order to enable it.

MATLAB Specific Properties

Property Name (Key)	Default (Value)	Description
`spark.matlab.worker.del`	`false`	For use in standalone/ interactive mode only. If set to true, a Spark deployable MATLAB application executed within the MATLAB desktop environment, launches another MATLAB session as worker, and will enter the debugger. Logging information is directed to `log_<nbr>.txt`.
`spark.matlab.worker.re`	`true`	When set to `true`, a Spark executor pools workers and reuses them from one stage to the next. Workers

Property Name (Key)	Default (Value)	Description
		terminate when the executor under which the workers are running terminates.
spark.matlab.worker.pr	false	Only valid when using a session of MATLAB as a worker. When set to true, it turns on the MATLAB Profiler and generates a Profile report that is saved to the file profworker_<split_index>_<socket pass>.mat.
spark.matlab.worker.nur	10000	Number of unique keys that can be held in a containers.Map object while performing *ByKey operations before map data is spilled to a file.

Monitoring and Logging

Property Name (Key)	Default (Value)	Description
spark.history.fs.logDi	file:/tmp/spark-events	Directory that contains application event logs to be loaded by the history server.
spark.eventLog.dir	file:///tmp/spark-events	Base directory in which Spark events are logged, if spark.eventLog.enabled is true. Within this base directory, Spark creates a sub directory for each application, and logs the events specific to the application in this directory. You can set this to a unified location like an HDFS

Property Name (Key)	Default (Value)	Description
		directory so history files can be read by the history server.
`spark.eventLog.enabled`	`false`	Whether to log Spark events This is useful for reconstructing the web UI after the application has finished.

Name-Value Pair Arguments

Specify optional comma-separated pairs of `Name,Value` arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside single quotes (`' '`). You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

`'MCRRoot'` — Path to MATLAB Runtime that is used to execute driver application

character vector

A character vector specifying the path to MATLAB Runtime within single quotes `''`.

Example: `'MCRRoot', '/share/MATLAB/MATLAB_Runtime/v91'`

Data Types: `char`

`'SparkLogLevel'` — Set the Spark log level

`'ALL' | 'DEBUG' | 'ERROR' | 'FATAL' | 'INFO' | 'OFF' | 'TRACE' | 'WARN'`

Specify the log level to set as a character vector with log level enclosed in `''`.

Data Types: `char`

Properties

The properties of this class are hidden.

Methods

There are no user executable methods for this class.

Examples

Create DeploySparkMapReducer Object

Define Spark properties and create a `DeploySparkMapReducer` object.

```
sparkProperties = containers.Map( ...
 {'spark.executor.cores', ...
 'spark.executor.memory', ...
 'spark.yarn.executor.memoryOverhead', ...
 'spark.dynamicAllocation.enabled', ...
 'spark.shuffle.service.enabled', ...
 'spark.eventLog.enabled', ...
 'spark.eventLog.dir'}, ...
 {'1', ...
  '2g', ...
  '1024', ...
  'true', ...
  'true', ...
  'true', ...
  'hdfs://hadoopfs:54310/user/<username>/sparkdeploy'});

conf = matlab.mapreduce.DeploySparkMapReducer( ...
      'AppName','myTallApp', ...
      'Master','yarn-client', ...
      'SparkProperties',sparkProperties);

mapreducer(conf);
```

- “Example on Deploying Tall Arrays to a Spark Enabled Hadoop Cluster” on page 6-2

References

More About

- “Apache Spark Basics” on page 4-2

Introduced in R2016b

2

Methods — RDD

aggregate

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Aggregate the elements of each partition and subsequently the results for all partitions into a single value

Syntax

```
result = aggregate(obj,zeroValue,seqOp,combOp)
```

Description

`result = aggregate(obj,zeroValue,seqOp,combOp)` aggregates the elements into a single value using given combine functions specified by `seqOp` and `combOp`, and a neutral "zero value" specified by `zeroValue`.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a `RDD` object.

`zeroValue` — Neutral "zero value"

cell array of numbers

A neutral "zero value", specified as a cell array of numbers.

Data Types: `cell`

`seqOp` — Function to aggregate the values of each key

function handle

A function to aggregate the values of each key, specified as a function handle.

Data Types: `function_handle`

`combOp` — Function to aggregate results of `seqOp`

function handle

A function to aggregate results of `seqOp`, specified as a function handle.

Data Types: `function_handle`

Output Arguments

`result` — RDD containing aggregated elements

RDD object

An RDD containing aggregated elements, returned as an `RDD` object.

Examples

Aggregate Elements of an RDD into a Single Value

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% Aggregate
seqOp = @(x,y)({x{1} + y, x{2} + 1});
combOp = @(x,y)({x{1} + y{1}, x{2} + y{2}});
x = sc.parallelize({1, 2, 3, 4});
y = x.aggregate({0, 0}, seqOp, combOp) % {10,4}
```

See Also

matlab.compiler.mlspark.RDD.aggregateByKey |
matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

aggregateByKey

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Aggregate the values of each key, using given combine functions and a neutral "zero value"

Syntax

```
result = aggregateByKey(obj,zeroValue,seqFunc,combFunc,
numPartitions)
```

Description

`result = aggregateByKey(obj,zeroValue,seqFunc,combFunc,
numPartitions)` aggregates the values of each key, using given combine functions specified by `seqFunc` and `combFunc`, and a neutral "zero value" specified by `zeroValue`. The input argument `numPartitions` is optional.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a `RDD` object.

`zeroValue` — Neutral "zero value"

cell array of numbers

A neutral "zero value", specified as a cell array of numbers.

Data Types: `cell`

`seqFunc` — Function to aggregate the values of each key

function handle

Function that aggregates the values of each key, specified as a function handle.

Data Types: `function_handle`

`combFunc` — Function to aggregate results of seqFunc

function handle

Function to aggregate results of `seqFunc`, specified as a function handle.

Data Types: `function_handle`

`numPartitions` — Number of partitions to create

scalar value

Number of partitions to create, specified as a scalar value. This argument is optional.

Data Types: `double`

Output Arguments

`result` — RDD containing elements aggregated by key

RDD object

An RDD containing elements aggregated by key, returned as a RDD object.

Examples

Aggregate the Values of Each Key

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% aggregateByKey
x = sc.parallelize({'a','b','c','d'},4);
y = x.map(@(x)({x,1}));
z = y.aggregateByKey(10,@(x,y)(x+y),@(x,y)(x+y));
viewRes = z.collect()  % { {'d',11},{'a',11},{'b',11},{'c',11}}
```

See Also

matlab.compiler.mlspark.RDD.aggregate |
matlab.compiler.mlspark.RDD.combineByKey |

| matlab.compiler.mlspark.RDD.groupByKey | matlab.compiler.mlspark.RDD.reduceByKey | matlab.compiler.mlspark.RDD.sortByKey | matlab.compiler.mlspark.RDD.subtractByKey | matlab.compiler.mlspark.RDD.map | matlab.compiler.mlspark.RDD.collect | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

cache

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Store an RDD in memory

Syntax

```
cache(obj)
```

Description

`cache(obj)` stores an RDD object specified by `obj` in the memory of the *executors* across a cluster.

Input Arguments

`obj` — RDD to be cached in memory

RDD object

An RDD to be cached in memory, specified as an RDD object.

Examples

Cache an RDD in Memory

Store an RDD in the memory of the executors across the cluster.

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% cache
```

```
myFile = sc.textFile('airlinesmall.csv');
myFile.cache();
```

See Also

matlab.compiler.mlspark.SparkContext.textFile

Introduced in R2016b

cartesian

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Create an RDD that is the Cartesian product of two RDDs

Syntax

```
result = cartesian(obj1,obj2)
```

Description

`result = cartesian(obj1,obj2)` creates a new RDD that is the Cartesian product between two RDDs, `obj1` and `obj2`.

Input Arguments

`obj1` — First input RDD

RDD object

The first input RDD, specified as a RDD object.

`obj2` — Second input RDD

RDD object

The second input RDD, specified as a RDD object.

Output Arguments

`result` — RDD representing the Cartesian product of two RDDs

RDD object

An RDD representing the Cartesian product of two RDDs, returned as a RDD object.

Examples

Compute Cartesian Product Between Two RDDs

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% cartesian
x = sc.parallelize({'A', 2, 'C'});
y = sc.parallelize({'D', 1});
out = x.cartesian(y).collect(); % {{'A','D'},{'A',1},{2,'D'},{2,1},{'C','D'},{'C',1}}
```

See Also

matlab.compiler.mlspark.RDD.collect |
matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

checkpoint

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Mark an RDD for checkpointing

Syntax

```
checkpoint(obj)
```

Description

`checkpoint(obj)` marks an RDD for checkpointing.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD that is to be marked for checkpointing, specified as an `RDD` object.

Examples

Mark an RDD for Checkpointing

Use the `checkpoint` method to save an RDD to a file inside the checkpoint directory.

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                         'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% checkpoint
sc.setCheckpointDir('myDir')
```

```
myFile = sc.parallelize({1,2,3});
mapRDD = myFile.map(@(x)({x,1}));
mapRDD.checkpoint();
```

See Also

matlab.compiler.mlspark.SparkContext.setCheckpointDir | matlab.compiler.mlspark.RDD.getCheckpointFile | matlab.compiler.mlspark.RDD.map | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

coalesce

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Reduce the number of partitions in an RDD

Syntax

```
result = coalesce(obj,numPartitions,doShuffle)
```

Description

`result = coalesce(obj,numPartitions,doShuffle)` reduces the number of partitions in an RDD to a number specified by `numPartitions`.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a RDD object.

`numPartitions` — Number of partitions to create

scalar value

Number of partitions to create, specified as a scalar value.

Data Types: `double`

`doShuffle` — Perform shuffle

`false` (default) | `true`|`false`

Specify whether shuffle must be performed or not. By default `doShuffle` is set to `false`.

Data Types: `logical`

Output Arguments

`result` — RDD with reduced number of partitions

RDD object

An RDD with reduced number of partitions, returned as a RDD object.

Examples

Reduce the Number of Partitions in an RDD

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% coalesce
inputRDD = sc.parallelize({'A','B','C','A','B'},2);
redRDD= inputRDD.map(@(x)({x,1})).reduceByKey(@(x,y)(x+y),3);
coaRDD = redRDD.checkpoint(2);
viewRes = coaRDD.glom.collect() % {{{'B',2}},{{'C',1},{'A',2}}}
```

See Also

matlab.compiler.mlspark.RDD.reduceByKey | matlab.compiler.mlspark.RDD.map | matlab.compiler.mlspark.RDD.glom | matlab.compiler.mlspark.RDD.collect | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

cogroup

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Group data from RDDs sharing the same key

Syntax

```
result = cogroup(obj1,obj2,numPartitions)
```

Description

`result = cogroup(obj1,obj2,numPartitions)` groups the data from `obj1` and `obj2` that share the same key.

Input Arguments

`obj1` — First input RDD

RDD object

The first input RDD, specified as a `RDD` object.

`obj2` — Second input RDD

RDD object

The second input RDD, specified as a `RDD` object.

`numPartitions` — Number of partitions to create

scalar value

Number of partitions to create, specified as a scalar value.

Data Types: `double`

Output Arguments

`result` — RDD containing grouped data

RDD object

An RDD containing grouped data, returned as a RDD object.

Examples

Group Data from Key-Value Pair RDDs Sharing the Same Key

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% cogroup
x = sc.parallelize({ {'a',1}, {'b', 4} });
y = sc.parallelize({ {'a',2} });
z=x.cogroup(y);
```

See Also

matlab.compiler.mlspark.RDD.coalesce |
matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

collect

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Return a MATLAB cell array that contains all of the elements in an RDD

Syntax

```
result = collect(obj)
```

Description

`result = collect(obj)` returns a MATLAB cell array that contains all of the elements in `obj`.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as an RDD object.

Output Arguments

`result` — Eelements of an RDD

cell array

Elements of an RDD, returned as a cell array.

Examples

Return Contents of an RDD

```
%% Connect to Spark
```

```
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% Collect
x = sc.parallelize({'A', 2, 'C'});
y = sc.parallelize({'D', 1});
z = x.cartesian(y);
out = z.collect()
```

See Also

matlab.compiler.mlspark.RDD.collectAsMap | matlab.compiler.mlspark.RDD.cartesian | matlab.compiler.mlspark.RDD.glom | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

collectAsMap

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Return the key-value pairs in an RDD as a MATLAB `containers.Map` object

Syntax

```
result = collectAsMap(obj)
```

Description

`result = collectAsMap(obj)` returns the key-value pairs in `obj` as a MATLAB `containers.Map` object.

Input Arguments

`obj` — RDD object

`RDD` object

An RDD object, specified as a `RDD` object.

Output Arguments

`result` — Key-value pairs in an RDD

`containers.Map` object

The key-value pairs in an RDD, returned as a MATLAB `containers.Map` object.

Examples

Return the Key-Value Pairs in an RDD

```
% Connect to Spark
```

```
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

% Collect as Map
x = sc.parallelize({ {'a',1} ,{'b',2} });
c = x.collectAsMap() % c is a MAP with 'a','b' as keys and 1,2 as values
```

See Also

matlab.compiler.mlspark.RDD.collect | matlab.compiler.mlspark.RDD.cartesian | matlab.compiler.mlspark.RDD.glom | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

combineByKey

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Combine the elements for each key using a custom set of aggregation functions

Syntax

```
result = combineByKey(obj,createCombiner,mergeValue,mergeCombiners,
numPartitions)
```

Description

`result = combineByKey(obj,createCombiner,mergeValue,mergeCombiners, numPartitions)` combines the elements for each key using a custom set of aggregation functions: `createCombiner` and `mergeValue`. The input argument `numPartitions` specifies the number of partitions to create in the resulting RDD.

Input Arguments

`obj` — Input RDD to combine

RDD object

An input RDD to combine, specified as a RDD object.

`createCombiner` — Combiner function (C), given a value (V)

function handle

Combiner function (C), given a value (V), specified as a function handle.

Data Types: `function_handle`

`mergeValue` — Function representing a merging of the given value (V) with an existing combiner (C)

function handle

Function representing a merging of the given value (V) with an existing combiner (C), specified as a function handle.

Data Types: `function_handle`

`mergeCombiners` — Function representing the merging of two combiners to return a new combiner

function handle

Function representing the merging of two combiners to return a new combiner, specified as a function handle.

Example:

Data Types: `function_handle`

`numPartitions` — Number of partitions to create

scalar value

Number of partitions to create, specified as a scalar value.

Example:

Data Types: `double`

Output Arguments

`result` — Cell array containing the elements of an RDD

cell array

A MATLAB cell array containing the elements of an RDD.

Examples

Combine the Elements for Each Key

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);
```

```
%% combineByKey
inputRdd = sc.parallelize({{'a',1}, {'b',1},{'a',1}});
resRdd = inputRdd.combineByKey(@(value) num2str(value), ...
            @(acc,value) strcat(acc, value), ...
            @(rdd1value, rdd2Value) strcat(rdd1Value, rdd2Value));
viewRes = resRdd.collect()
```

See Also

matlab.compiler.mlspark.RDD.aggregateByKey | matlab.compiler.mlspark.RDD.foldByKey | matlab.compiler.mlspark.RDD.groupByKey | matlab.compiler.mlspark.RDD.reduceByKey | matlab.compiler.mlspark.RDD.sortByKey | matlab.compiler.mlspark.RDD.subtractByKey | matlab.compiler.mlspark.RDD.collect | matlab.compiler.mlspark.RDD.glom | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

count

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Count number of elements in an RDD

Syntax

```
result = count(obj)
```

Description

`result = count(obj)` counts the number of elements in `obj`.

Input Arguments

`obj` — Input RDD to count

RDD object

An input RDD to count, specified as a RDD object.

Output Arguments

`result` — Number of elements in the input RDD

scalar

The number of elements in an input RDD, returned as a scalar.

Examples

Count the Number of Elements in an RDD

```
% Connect to Spark
```

```
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

% count
countVal = sc.parallelize({1, 2, 3, 4, 5}).count();
disp(countVal);
```

See Also

matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

distinct

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Return a new RDD containing the distinct elements of an existing RDD

Syntax

```
result = distinct(obj,numPartitions)
```

Description

`result = distinct(obj,numPartitions)` returns a new RDD `result` containing the distinct elements of `obj` by eliminating duplicate values.

Input Arguments

`obj` — Input RDD to remove duplicates from

RDD object

An input RDD, specified as a RDD object.

`numPartitions` — Number of partitions to create

scalar value

Number of partitions to create, specified as a scalar value.

Data Types: `double`

Output Arguments

`result` — RDD containing distinct elements

RDD object

A pipelined RDD containing distinct elements of the input RDD, returned as a RDD object.

Examples

Get the Distinct Elements of an RDD

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% distinct
inputRDD = sc.parallelize({1,2,1,2});
dRDD = inputRDD.distinct();
viewRes = dRDD.glom().collect()  %{1,2}
```

See Also

matlab.compiler.mlspark.RDD.glom | matlab.compiler.mlspark.RDD.collect | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

filter

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Return a new RDD containing only the elements that satisfy a predicate function

Syntax

```
result = filter(obj,func,varargin)
```

Description

`result = filter(obj,func,varargin)` applies a predicate function `func` to every element in `obj`. Elements that satisfy the criteria set by the predicate function are retained, others are discarded. A predicate function is one that returns `true` in a given logical function.

Input Arguments

`obj` — Input RDD to be filtered

RDD object

An input RDD to be filtered, specified as a RDD object.

`func` — Predicate function

function handle

Predicate function, specified as a function handle. A predicate function returns `true` in a given logical function.

Data Types: `function_handle`

`varargin` — Variable-length input argument list

valid inputs to the predicate function

A variable-length input argument list representing inputs to the predicate function.

Output Arguments

`result` — Output RDD

RDD object

An output RDD, returned as a RDD object.

Examples

Apply a Predicate Function to an RDD

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% filter
rdd = sc.parallelize({1, 2, 3, 4, 5});
res = rdd.filter(@(x) mod(x,2) == 0).collect();
```

See Also

matlab.compiler.mlspark.RDD.map | matlab.compiler.mlspark.RDD.flatMap | matlab.compiler.mlspark.RDD.collect | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

flatMap

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Return a new RDD by first applying a function to all elements of an existing RDD, and then flattening the results

Syntax

```
result = flatMap(obj,func,varargin)
```

Description

`result = flatMap(obj,func,varargin)` returns a new RDD `result` by first applying a function `func` to all elements of `obj`, and then flattening the results.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD on which a function is applied, specified as a `RDD` object.

`func` — Function to apply to each element

function handle

Function to be applied to each element in the input RDD, specified as a function handle.

Example:

Data Types: `function_handle`

`varargin` — Variable-length input argument list

valid inputs to the transformation function

A variable-length input argument list representing inputs to the function that is being applied.

Output Arguments

`result` — Output RDD

RDD object

An output RDD, returned as a RDD object.

Examples

Apply a Function to an RDD and Flatten the Results

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% flatMap
inRDD = sc.parallelize({'A','B'});
flatRDD = inRDD.flatMap(@(x)({x,1}));
viewRes = flatRDD.collect()
```

See Also

matlab.compiler.mlspark.RDD.flatMapValues | matlab.compiler.mlspark.RDD.map | matlab.compiler.mlspark.RDD.filter | matlab.compiler.mlspark.RDD.collect | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

flatMapValues

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Pass each value in the key-value pair RDD through a `flatMap` method without changing the keys

Syntax

```
result = flatMapValues(obj,func)
```

Description

`result = flatMapValues(obj,func)` passes each value in a key-value pair RDD `obj` through the `flatMap` method without changing the keys. `func` represents the function to be applied by the `flatMap` method.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD on which a transformation function is applied, specified as a `RDD` object.

`func` — Function to apply to each element

function handle

Function to be applied to each element in the input RDD, specified as a function handle.

Example:

Data Types: `function_handle`

Output Arguments

`result` — Output RDD

RDD object

An output pipelined RDD, returned as a RDD object.

Examples

Tokenize an RDD

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% flatMapValues
inRDD = sc.parallelize({ {'AA', {1,2,3}}, {'BB',3}, {'CC', {'cc',4}} });
f = @(x)(x);
out = inRDD.flatMapValues(f).collect();
% out : {{'AA',1},{'AA',2},{'AA',3},{'BB',3},{'CC','cc'},{'CC',4}}
```

See Also

matlab.compiler.mlspark.RDD.flatMap | matlab.compiler.mlspark.RDD.map | matlab.compiler.mlspark.RDD.collect | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

fold

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Aggregate elements of each partition and the subsequent results for all partitions

Syntax

```
result = fold(obj,zeroValue,func)
```

Description

`result = fold(obj,zeroValue,func)` aggregates the elements of each partition in `obj` and the subsequent results for all the partitions, using an associative function `func` and a neutral "zero value" represented by `zeroValue`.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a `RDD` object.

`zeroValue` — Neutral "zero value"

cell array of numbers

A neutral "zero value", specified as a cell array of numbers.

Data Types: `cell`

`func` — Function for the folding action

function handle

A function for the folding action, specified as a function handle.

Data Types: `function_handle`

Output Arguments

`result` — Result of the folding action

scalar

Result of the folding action, returned as a scalar.

Examples

Accumulate the Elements of Each Partition and Subsequent Partitions

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% fold
foldVal = sc.parallelize({1, 2, 3, 4, 5}, 1).fold(10, @(x,y)(x+y));
disp(foldVal);
```

See Also

matlab.compiler.mlspark.RDD.foldByKey | matlab.compiler.mlspark.RDD.groupBy | matlab.compiler.mlspark.RDD.collect | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

foldByKey

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Merge the values for each key using an associative function and a neutral "zero value"

Syntax

```
result = foldByKey(obj,zeroValue,func,numPartitions)
```

Description

`result = foldByKey(obj,zeroValue,func,numPartitions)` merges the values for each key in `obj` using an associative function `func` and a neutral "zero value" represented by `zeroValue`. The input argument `numPartitions` specifies the number of partitions to create in the resulting RDD.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a `RDD` object.

`zeroValue` — Neutral "zero value"

cell array of numbers

A neutral "zero value", specified as a cell array of numbers.

Data Types: `cell`

`func` — Function for folding the values of each key

function handle

Function for folding the values of each key, specified as a function handle.

Data Types: `function_handle`

`numPartitions` — Number of partitions to create

scalar value

Number of partitions to create, specified as a scalar value.

Data Types: `double`

Output Arguments

`result` — RDD containing the aggregation result

RDD object

A pipelined RDD containing the aggregation result, returned as a RDD object.

Examples

Merge Values for Each Key

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% foldByKey
x = sc.parallelize({ {'a',1}, {'b',1}, {'a',1} });
y = x.foldByKey(5, @(x,y)(x+y));
viewRes = y.collect() % {{'a',7},{'b',6}}
```

See Also

matlab.compiler.mlspark.RDD.fold | matlab.compiler.mlspark.RDD.aggregateByKey | matlab.compiler.mlspark.RDD.combineByKey | matlab.compiler.mlspark.RDD.groupByKey | matlab.compiler.mlspark.RDD.reduceByKey | matlab.compiler.mlspark.RDD.sortByKey | matlab.compiler.mlspark.RDD.subtractByKey | matlab.compiler.mlspark.RDD.map | matlab.compiler.mlspark.RDD.collect | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

fullOuterJoin

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Perform a full outer join between two key-value pair RDDs

Syntax

```
result = fullOuterJoin(obj1,obj2,numPartitions)
```

Description

`result = fullOuterJoin(obj1,obj2,numPartitions)` performs a full outer join between two key-value pair RDDs, `obj1` and `obj2`. `numPartitions` specifies the number of partitions to create in the resulting RDD.

Input Arguments

`obj1` — First input RDD to be joined

RDD object

Input RDD to be joined, specified as a `RDD` object. RDD must be a key-value pair RDD.

`obj2` — Second input RDD to be joined

RDD object

Input RDD to be joined, , specified as a `RDD` object. RDD must be a key-value pair RDD.

`numPartitions` — Number of partitions to create

scalar value

Number of partitions to create, specified as a scalar value.

Data Types: `double`

Output Arguments

`result` — RDD containing all pairs of elements with matching keys in the two input RDDs

RDD object

A pipelined RDD containing all pairs of elements with matching keys in the two input RDDs, returned as a RDD object.

Examples

Perform a Full Outer Join

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% fullOuterJoin
x = sc.parallelize({ {'a',1}, {'b', 4} });
y = sc.parallelize({ {'a',2}, {'c', 8} });
z = x.fullOuterJoin(y);
viewRes = z.collect() % {{'a',{1,2}},{'b',{4,[]}},{'c',{[],8}}}
```

See Also

matlab.compiler.mlspark.RDD.join | matlab.compiler.mlspark.RDD.leftOuterJoin | matlab.compiler.mlspark.RDD.rightOuterJoin | matlab.compiler.mlspark.RDD.collect | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

getCheckpointFile

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Get the name of the file to which an RDD is checkpointed

Syntax

```
file = getCheckpointFile(obj)
```

Description

`file = getCheckpointFile(obj)` gets the name of the file to which the RDD `obj` is checkpointed.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as an `RDD` object.

Output Arguments

`file` — File name to which an RDD was checkpointed

character vector

The name of the file to which an RDD was checkpointed, returned as a character vector.

Examples

Get Checkpointed File Name

Get the name of the file to which an RDD was checkpointed.

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% getCheckpointFile
sc.setCheckpointDir('myDir')  % set the checkpoint directory
x = sc.parallelize({1,2,3})
y = x.map(@(x)({x,1}));
y.checkpoint()  % tell spark to checkpoint the RDD
y.collect()
% need to call collect, so that spark actually materializes the RDD
% and checkpoints to the myDir directory
y.getCheckpointFile()
```

See Also

matlab.compiler.mlspark.RDD.checkpoint | matlab.compiler.mlspark.SparkContext.setCheckpointDir | matlab.compiler.mlspark.RDD.map | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

getDefaultReducePartitions

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Get the number of default reduce partitions in an RDD

Syntax

```
numPartitions = getDefaultReducePartitions(obj)
```

Description

`numPartitions = getDefaultReducePartitions(obj)` gets the number of default reduce partitions in `obj`.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as an `RDD` object

Output Arguments

`numPartitions` — Number of default reduce partitions in the input RDD

scalar value

The number of default reduce partitions in the input RDD, returned as a scalar value.

Examples

Get Default Reduce Partitions

Get the number of default reduce partitions in an RDD.

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% getDefaultReducePartitions
x = sc.parallelize({1,2,3});
y = x.map(@(x)({x,1}));
z1 = y.reduceByKey(@(a,b)(a+b));
z2 = y.reduceByKey(@(a,b)(a+b), 3);

z1.getDefaultReducePartitions() % ans is 1
z2.getDefaultReducePartitions() % ans is 3, as the 2nd argument to reduceByKey is the r
```

See Also

matlab.compiler.mlspark.RDD.getNumPartitions | matlab.compiler.mlspark.RDD.map | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

getNumPartitions

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Return the number of partitions in an RDD

Syntax

```
numPartitions = getNumPartitions(obj)
```

Description

`numPartitions = getNumPartitions(obj)` returns the number of partitions in `obj`.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as an `RDD` object.

Output Arguments

`numPartitions` — Number of partitions

scalar value

Number of partitions in the input RDD, returned as a scalar value.

Examples

Number of Partitions in an RDD

Use the `getNumPartitions` method to return the number of partitions in an RDD.

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% getNumPartitions
inputRDD = sc.parallelize({'A','B','C','A','B'},2);
redRDD= inputRDD.map(@(x)({x,1})).reduceByKey(@(x,y)(x+y),3);
coaRDD = redRDD.coalesce(2); % {{{'B',2}},{{'C',1},{'A',2}}}*
disp(['Number of Partitions: ' num2str(coaRDD.getNumPartitions())]);
```

See Also

matlab.compiler.mlspark.RDD.getDefaultReducePartitions | matlab.compiler.mlspark.RDD.map | matlab.compiler.mlspark.RDD.coalesce | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

glom

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Coalesce all elements within each partition of an RDD

Syntax

```
result = glom(obj)
```

Description

`result = glom(obj)` returns an RDD `result` created by coalescing all elements within each partition of `obj`.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a RDD object.

Output Arguments

`result` — RDD containing coalesced elements within each partition of the input RDD

RDD object

A pipelined RDD containing coalesced elements within each partition of the input RDD, returned as a RDD object.

Examples

Coalesce All Elements Within Each Partition

```
%% Connect to Spark
```

```
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% glom
inputRDD = sc.parallelize({'A','B','C','D','E','C','B'});
mapRDD = inputRDD.map(@(x)({x,1}));
redRDD = mapRDD.reduceByKey(@(x,y)(x+y),3);
out = redRDD.glom().collect() % { {{'C',2}}, {{'A',1},{'D',1}}, {{'B',2},{'E',1}} }
% 3 cell arrays as 3 partitions were created by reduceByKey
```

See Also

matlab.compiler.mlspark.RDD.collect | matlab.compiler.mlspark.RDD.collectAsMap | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

groupBy

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Return an RDD of grouped items

Syntax

```
result = groupBy(obj,func,numPartitions)
```

Description

`result = groupBy(obj,func,numPartitions)` groups the elements of `obj` according a user-specified criteria denoted by `func`. `numPartitions` specifies the number of partitions to create in the resulting RDD.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a `RDD` object.

`func` — Function to group by

function handle

Function performing grouping, specified as a function handle.

Data Types: `function_handle`

`numPartitions` — Number of partitions to create

scalar value

Number of partitions to create, specified as a scalar value.

Data Types: `double`

Output Arguments

`result` — RDD containing grouped elements

RDD object

A pipelined RDD containing grouped elements of the input RDD, returned as a RDD object.

Examples

RDD of Grouped Items

Groups the elements of an RDD according a user-specified criteria.

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% groupBy
inRDD = sc.parallelize({1,2,3,4,5});
outRDD = inRDD.groupBy(@(x)(mod(x,2))).collect(); % {{0,{2,4}},{1,{1,3,5}
```

See Also

matlab.compiler.mlspark.RDD.groupByKey |
matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

groupByKey

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Group the values for each key in the RDD into a single sequence

Syntax

```
result = groupByKey(obj,numPartitions)
```

Description

`result = groupByKey(obj,numPartitions)` groups the values for each key in `obj` into a single sequence. `numPartitions` specifies the number of partitions to create in the resulting RDD.

Input Arguments

`obj` — Input RDD to group

RDD object

An input RDD to group, specified as a `RDD` object.

`numPartitions` — Number of partitions to create

scalar value

Number of partitions to create, specified as a scalar value.

Data Types: `double`

Output Arguments

`result` — RDD containing elements grouped by key

RDD object

A pipelined RDD containing elements of the input RDD grouped by key, returned as a RDD object.

Examples

Group into a Single Sequence RDD Using a Key

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% groupByKey
inRDD = sc.parallelize({{'a',1},{'b',2}, {'a','3'}, {'b',4}});
outRDD = inRDD.groupByKey().collect(); % {{'a',{1,'3'}},{'b',{2,4}}}'
```

See Also

matlab.compiler.mlspark.RDD.groupBy |
matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

intersection

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Return the set intersection of one RDD with another

Syntax

```
result = intersection(obj1,obj2)
```

Description

`result = intersection(obj1,obj2)` returns elements that are the set intersection of `obj1` and `obj2`.

Input Arguments

`obj1` — First input RDD

RDD object

An input RDD, , specified as a `RDD` object.

`obj2` — Second input RDD

RDD object

An input RDD, specified as a `RDD` object.

Output Arguments

`result` — RDD containing the set intersection of the two input RDDs

RDD object

A pipelined RDD containing the set intersection of the two input RDDs, returned as a `RDD` object.

Examples

Set Intersection of RDDs

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% intersection
x = sc.parallelize({'A','B','C'});
y = sc.parallelize({'B','D'});
z = sc.parallelize({'E','F'});
out1 = x.intersection(y).collect(); % {'B'}
```

See Also

matlab.compiler.mlspark.RDD.subtract | matlab.compiler.mlspark.RDD.union | matlab.compiler.mlspark.RDD.collect | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

isEmpty

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Determine if an RDD contains any elements

Syntax

```
tf = isEmpty(obj)
```

Description

`tf = isEmpty(obj)` returns a logical `1 (true)` if the input RDD `obj` contains no elements, and a logical `0 (false)` otherwise.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as an `RDD` object.

Output Arguments

`tf` — Input RDD is empty or not

logical `1 (true)|0 (false)`

Indicates whether the input RDD is empty or not, returned as a logical value.

Examples

Check If an RDD Contains Elements

Check if an RDD contains any elements.

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% isEmpty
x = sc.parallelize({});
tf = x.map(@(x)({x,1})).isEmpty(); % tf=1
```

See Also

matlab.compiler.mlspark.RDD.collect |
matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

join

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Return an RDD containing all pairs of elements with matching keys

Syntax

```
result = join(obj1,obj2,numPartitions)
```

Description

`result = join(obj1,obj2,numPartitions)` performs an inner join on `obj1` and `obj2` and returns an RDD `result` of key-value pairs containing all pairs of elements with matching keys in the input RDDs. `obj1` and `obj2` must be key-value pair RDDs. `numPartitions` specifies the number of partitions to create in the resulting RDD.

Input Arguments

`obj1` — First input RDD to be joined

RDD object

The first input RDD to be joined, specified as a `RDD` object. RDD must be a key-value pair RDD.

`obj2` — Second input RDD to be joined

RDD object

The second input RDD to be joined, specified as a `RDD` object. RDD must be a key-value pair RDD.

`numPartitions` — Number of partitions to create

scalar value

Number of partitions to create, specified as a scalar value.

Data Types: `double`

Output Arguments

`result` — RDD containing all pairs of elements with matching keys in the two input RDDs

RDD object

A pipelined RDD containing all pairs of elements with matching keys in the two input RDDs, returned as a RDD object.

Examples

Join Two RDDs

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% join
x = sc.parallelize({ {'a',11}, {'b', {1,2,3}}, {'b','22'} ,{'c','dd'} });
y = sc.parallelize({ {'a',33}, {'b',44} , {'a',55}, {'d', 5 }});
z = x.join(y, 2);
viewRes = z.collect() % {{'b',{{1,2,3},44}},{'b',{'22',44}},{'a',{11,33}},{'a',{11,55}}
```

See Also

matlab.compiler.mlspark.RDD.fullOuterJoin | matlab.compiler.mlspark.RDD.leftOuterJoin | matlab.compiler.mlspark.RDD.rightOuterJoin | matlab.compiler.mlspark.RDD.collect | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

keyBy

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Create tuples of the elements in an RDD by applying a function

Syntax

```
result = keyBy(obj,func)
```

Description

`result = keyBy(obj,func)` takes a function `func` that returns a key for any given element in `obj`. The `keyBy` method applies this function to all the elements in `obj` and returns an output RDD `result` of key-value pairs.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a `RDD` object.

`func` — Function to be applied

function handle

Function to be applied, specified as a function handle.

Data Types: `function_handle`

Output Arguments

`result` — RDD containing tuples of the elements in the input RDD

RDD object

A pipelined RDD containing tuples of the elements in the input RDD, returned as a RDD object.

Examples

Create a Tuple of Keys and Values

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% keyBy
x = sc.parallelize({1,2,3});
c = x.keyBy(@(x)(x*x)).collect(); % {{1,1},{4,2},{9,3}}
```

See Also

matlab.compiler.mlspark.RDD.keys | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

keys

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Return an RDD with the keys of each tuple

Syntax

```
result = keys(obj)
```

Description

`result = keys(obj)` returns an RDD `result` with the keys of each tuple in `obj`.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a RDD object.

Output Arguments

`result` — RDD containing the keys of each tuple in the input RDD

RDD object

A pipelined RDD containing the keys of each tuple in the input RDD, returned as a RDD object.

Examples

Get Keys From a Key-Value RDD

```
%% Connect to Spark
```

```
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% keys
m = sc.parallelize({ {'AA', {5,15} }, {'BB', 200}});
out = m.keys().collect();
```

See Also

matlab.compiler.mlspark.RDD.keyBy |
matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

leftOuterJoin

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Perform a left outer join

Syntax

```
result = leftOuterJoin(obj1,obj2,numPartitions)
```

Description

`result = leftOuterJoin(obj1,obj2,numPartitions)` performs a left outer join on `obj1` and `obj2`. `numPartitions` specifies the number of partitions to create in the resulting RDD.

Input Arguments

`obj1` — First input RDD to be joined

RDD object

Input RDD to be joined, specified as a `RDD` object. RDD must be a key-value pair RDD.

`obj2` — Second input RDD to be joined

RDD object

Input RDD to be joined, specified as a `RDD` object. RDD must be a key-value pair RDD.

`numPartitions` — Number of partitions to create

scalar value

Number of partitions to create, specified as a scalar value.

Data Types: `double`

Output Arguments

`result` — RDD containing all pairs of elements with matching keys in the two input RDDs

RDD object

A pipelined RDD containing all pairs of elements with matching keys in the two input RDDs, returned as a RDD object.

Examples

Perform a Left Outer Join

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% leftOuterJoin
x = sc.parallelize({ {'a',1}, {'b', 4} });
y = sc.parallelize({ {'a',2} });
z = x.leftOuterJoin(y);
viewRes = z.collect()
```

See Also

matlab.compiler.mlspark.RDD.fullOuterJoin | matlab.compiler.mlspark.RDD.join | matlab.compiler.mlspark.RDD.rightOuterJoin | matlab.compiler.mlspark.RDD.collect | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

map

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Return a new RDD by applying a function to each element of an input RDD

Syntax

```
result = map(obj,func,varargin)
```

Description

`result = map(obj,func,varargin)` returns a new RDD `result` by first applying a function `func` to all elements of `obj`. `varargin` represents a variable-length input argument list for the inputs to the function being applied.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a `RDD` object.

`func` — Function to be applied to each element

function handle

Function to be applied to each element in the input RDD, specified as a function handle.

Data Types: `function_handle`

`varargin` — Variable-length input argument list

valid inputs to the function that is being applied

A variable-length input argument list, specifying inputs to the function that is being applied.

Output Arguments

`result` — RDD containing mapped elements

RDD object

A pipelined RDD containing mapped elements of the input RDD, returned as a RDD object.

Examples

Apply a Function to Each Element of an RDD

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% map
inputRDD = sc.parallelize({'A','B','C','A','B'},2);
redRDD= inputRDD.map(@(x)({x,1})).collect();
```

See Also

matlab.compiler.mlspark.RDD.flatMap | matlab.compiler.mlspark.RDD.reduce | matlab.compiler.mlspark.RDD.collect | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

mapValues

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Pass each value in a key-value pair RDD through a map function without modifying the keys

Syntax

```
result = mapValues(obj,func)
```

Description

`result = mapValues(obj,func)` passes each value in a key-value pair RDD `obj` through a map function `func` without modifying the keys.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a `RDD` object.

`func` — Function to be applied to each element

function handle

Function to be applied to each element, specified as a function handle.

Data Types: `function_handle`

Output Arguments

`result` — RDD containing mapped elements

RDD object

A pipelined RDD containing mapped elements of the input RDD, returned as a RDD object.

Examples

Apply Function to Each Value in an RDD

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% mapValues
x = sc.parallelize({'A','B','A'});

% reduce by key the above keys and square each of the values,
% so {‘A’,1} -> {‘A’,1*1}, {‘B’, 2} -> {‘B’, 2*2}

y = x.map(@(x)({x,1})).reduceByKey(@(x,y)(x+y)).mapValues(@(x)(x*x))
z = y.collect() % {{'A',4},{'B',1}}
```

See Also

matlab.compiler.mlspark.RDD.map | matlab.compiler.mlspark.RDD.flatMap | matlab.compiler.mlspark.RDD.collect | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

keyLimit

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Return threshold of unique keys that can be stored before spilling to disk

Syntax

```
result = keyLimit(obj)
```

Description

`result = keyLimit(obj)` returns the threshold of unique keys in `obj` that can be stored in memory before spilling to disk.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as an RDD object.

Output Arguments

`result` — Threshold of unique keys

scalar value

Threshold of unique keys that can be stored before spilling to disk, returned as a scalar value.

Examples

Get Threshold of Unique Keys

Use the `keyLimit` method to return the threshold of unique keys that can be stored in a containers.Map object that specifies Spark properties. Keys that breach the threshold are spilled to disk.

```
%% Connect to Spark
% Change number of keys from a default threshold of 10,000 to 500
sparkProp = containers.Map( ...
    {'spark.executor.cores',...
    'spark.executor.memory',...
    'spark.executor.instances',...
    'spark.matlab.worker.numOfKeys', ...
    }, ...
    {'1',...
    '2g',...
    '1', ...
    '500'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% keyLimit
x = sc.parallelize({1,2,3});
x.keyLimit % ans: 500
```

See Also

matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

persist

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Set the value of an RDD's storage level to persist across operations after it is computed

Syntax

```
persist(obj,storageLevel)
```

Description

`persist(obj,storageLevel)` sets a persistent storage level specified by `storageLevel` in RDD object `obj`. The default storage level is `MEMORY_ONLY`. Use the `persist` method to assign a new storage level if `obj` does not have a storage level set. You can also use it to set a persistent storage level in memory across operations.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as an `RDD` object.

`storageLevel` — New storage level to be assigned

`MEMORY_ONLY` (default) | `DISK_ONLY` | `MEMORY_AND_DISK` | `MEMORY_ONLY_2` | `DISK_ONLY_2` | `MEMORY_AND_DISK_2` | `OFF_HEAP`

New storage level to be assigned, specified as a character vector enclosed in `' '`. Use `storageLevel` to assign a new storage level if the RDD does not have a storage level set. The default storage level is `MEMORY_ONLY`.

Storage Level	Description
`MEMORY_ONLY`	Store the RDD in memory. If the RDD does not fit in memory, some paritions are not

Storage Level	Description
	cached, and are recomputed each time they are needed.
`DISK_ONLY`	Store the RDD partitions on disk.
`MEMORY_AND_DISK`	Store the RDD in memory. If it does not fit in memory, then spill to disk.
`MEMORY_ONLY_2`	Store the RDD in memory, but replicate each partition in two cluster nodes.
`DISK_ONLY_2`	Store the RDD partitions on disk, but replicate each partition in two cluster nodes.
`MEMORY_AND_DISK_2`	Store the RDD in memory. If it does not fit in memory, then spill to disk. Replicate each partition in two cluster nodes.
`OFF_HEAP`	Store RDD in serialized format. See Spark Programming Guide for more information.

Data Types: `char`

Examples

Persist an RDD

Use the `persist` method without any parameter to store an RDD in the memory of the executors across a cluster.

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% persist
myFile = sc.textFile('airlinesmall.csv');
myFile.persist();
```

```
myFile.unpersist();
```

See Also

matlab.compiler.mlspark.RDD.cache | matlab.compiler.mlspark.RDD.unpersist | matlab.compiler.mlspark.SparkContext.textFile | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

reduce

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Reduce elements of an RDD using the specified commutative and associative function

Syntax

```
result = reduce(obj,func)
```

Description

`result = reduce(obj,func)` reduces the elements of `obj` using the specified commutative and associative function `func`.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a RDD object.

`func` — Commutative and associative function to apply on elements of the RDD, specified as a function handle

function handle

Commutative and associative function that will be applied to elements of the RDD.

Data Types: `function_handle`

Output Arguments

`result` — Reduced elements of the input RDD

scalar value

Reduced elements of the input RDD, returned as a scalar.

Examples

Aggregate the Elements of an RDD Using a Binary Operator

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% Reduce
reduceVal = sc.parallelize({1, 2, 3, 4, 5}).reduce(@(x,y)(x+y));
disp(reduceVal);
```

See Also

matlab.compiler.mlspark.RDD.fold | matlab.compiler.mlspark.RDD.map | matlab.compiler.mlspark.RDD.reduceByKey | matlab.compiler.mlspark.RDD.reduceByKeyLocally | matlab.compiler.mlspark.RDD.collect | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

reduceByKey

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Merge the values for each key using an associative reduce function

Syntax

```
result = reduceByKey(obj,func,numPartitions)
```

Description

`result = reduceByKey(obj,func,numPartitions)` merges the values for each key in `obj` using an associative reduce function `func`. `numPartitions` specifies the number of partitions to create in the resulting RDD.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a RDD object.

`func` — Associative function to be applied

function handle

Associative function to be applied to the elements of the input RDD, specified as a function handle.

Data Types: `function_handle`

`numPartitions` — Number of partitions to create

scalar value

Number of partitions to create, specified as a scalar value.

Data Types: `double`

Output Arguments

`result` — RDD containing values reduced by key

RDD object

A pipelined RDD containing values reduced by key, returned as a RDD object.

Examples

Reduce Values By Key

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% reduceByKey
inputRDD = sc.parallelize({'A','B','C','A','B'},2);
redRDD= inputRDD.map(@(x)({x,1})).reduceByKey(@(x,y)(x+y),3);
```

See Also

matlab.compiler.mlspark.RDD.reduce |
matlab.compiler.mlspark.RDD.reduceByKeyLocally |
matlab.compiler.mlspark.RDD.map | matlab.compiler.mlspark.RDD.collect |
matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

reduceByKeyLocally

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Merge the values for each key using an associative reduce function, but return the results immediately to the driver

Syntax

```
result = reduceByKeyLocally(obj,func)
```

Description

`result = reduceByKeyLocally(obj,func)` merges the values for each key using an associative reduce function `func`, and returns the results immediately to the driver.

Input Arguments

`obj` — Input RDD

`RDD` object

An input RDD, specified as a `RDD` object.

`func` — Associative function to be applied

function handle

Associative function to be applied to the elements of the input RDD, specified as a function handle.

Data Types: `function_handle`

Output Arguments

`result` — List of key-value pairs

`containers.Map` object

A list of key-value pairs, returned in a `containers.Map` object.

Examples

Reduce Values for Each Key Using an Associative Reduce Function

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% reduceByKeyLocally
x = sc.parallelize({ {'a',10}, {'b',20}, {'a',30}, {'b',30 } }, 2);
m = x.reduceByKeyLocally(@(x,y)(x+y));
```

See Also

matlab.compiler.mlspark.RDD.reduce | matlab.compiler.mlspark.RDD.reduceByKey | matlab.compiler.mlspark.RDD.map | matlab.compiler.mlspark.RDD.collect | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

repartition

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Return a new RDD that has exactly `numPartitions` partitions

Syntax

```
result = repartition(obj,numPartitions)
```

Description

`result = repartition(obj,numPartitions)` returns a new RDD `result` that has exactly `numPartitions` partitions.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a `RDD` object.

`numPartitions` — Number of partitions to create

scalar value

Number of partitions to create, specified as a scalar value.

Data Types: `double`

Output Arguments

`result` — Reparitioned RDD

RDD object

A reparitioned RDD with partitions specified by `numPartitions`, returned as a `RDD` object.

Examples

Repartition an RDD

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% repartition
inputRDD = sc.parallelize({1,2,3,2,1},4);
outRDD1 = inputRDD.repartition(1); % {1,2,3,2,1}
viewRes = outRDD1.collect()
```

See Also

matlab.compiler.mlspark.RDD.getNumPartitions |
matlab.compiler.mlspark.RDD.getDefaultReducePartitions |
matlab.compiler.mlspark.RDD.collect |
matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

rightOuterJoin

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Perform a right outer join

Syntax

```
result = rightOuterJoin(obj1,obj2,numPartitions)
```

Description

`result = rightOuterJoin(obj1,obj2,numPartitions)` performs a right outer join between two key-value pair RDDs, `obj1` and `obj2`. `numPartitions` specifies the number of partitions to create in the resulting RDD.

Input Arguments

`obj1` — First input RDD to be joined

RDD object

Input RDD to be joined, specified as a `RDD` object. RDD must be a key-value pair RDD.

`obj2` — Second input RDD to be joined

RDD object

Input RDD to be joined, specified as a `RDD` object. RDD must be a key-value pair RDD.

`numPartitions` — Number of partitions to create

scalar value

Number of partitions to create, specified as a scalar value.

Data Types: `double`

Output Arguments

`result` — RDD containing all pairs of elements with matching keys in the two input RDDs
RDD object

A pipelined RDD containing all pairs of elements with matching keys in the two input RDDs, returned as a RDD object.

Examples

Right Outer Join an RDD

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% rightOuterJoin
x = sc.parallelize({ {'a',1}, {'b', 4} });
y = sc.parallelize({ {'a',2} });
z = y.rightOuterJoin(x);
viewRes = z.collect() % {{'a',{2,1}},{'b',{[],4}}}
```

See Also

matlab.compiler.mlspark.RDD.fullOuterJoin | matlab.compiler.mlspark.RDD.join | matlab.compiler.mlspark.RDD.leftOuterJoin | matlab.compiler.mlspark.RDD.collect | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

saveAsTallDatastore

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Save RDD as a MATLAB tall array to a binary file that can be read back using the `datastore` function

Syntax

```
saveAsMatlabBinaryFile(obj,path)
```

Description

`saveAsMatlabBinaryFile(obj,path)` saves `obj` as a MATLAB tall array in a binary file that can be read back using the `datastore` function. `path` specifies the directory location in which to save the binary file.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a RDD object.

`path` — Directory location

character vector

Directory location in which to save the binary file, specified as a character vector enclosed in `''`.

Data Types: `char`

Examples

Save RDD as a Tall Array

Save an RDD as a MATLAB tall array to a binary file that can be read back using the `datastore` function.

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% saveAsTallDatastore

% May require setting HADOOP_PREFIX or HADOOP_HOME environment variables to a
% valid Hadoop installation folder even if running locally.
% For example:
% setenv('HADOOP_PREFIX','/share/hadoop/hadoop-2.5.2')

inRDD = sc.parallelize({1,2,3,4,5});
% Store RDD in a file as a tall array that can be read back into MATLAB using datastore
inRDD.saveAsTallDatastore('myDir');
ds = datastore(['myDir' '/part*'], 'Type', 'tall');
ds.readall()
```

See Also

matlab.compiler.mlspark.RDD.saveAsKeyValueDatastore | matlab.compiler.mlspark.RDD.saveAsTextFile | matlab.compiler.mlspark.SparkContext.parallelize | `datastore`

Introduced in R2016b

saveAsKeyValueDatastore

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Save key-value RDD as a binary file that can be read back using the `datastore` function

Syntax

```
saveAsKeyValueDatastore(obj,path)
```

Description

`saveAsKeyValueDatastore(obj,path)` saves a key-value input RDD `obj` as a binary file that can be read back using the `datastore` function.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a `RDD` object.

`path` — Directory location

character vector

Directory location where binary file needs to be saved, specified as a character vector enclosed in `''`.

Data Types: `char`

Examples

Save RDD as a Key-Value Binary File

Save a key-value RDD as a binary file that can be read back using the `datastore` function.

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% saveAsKeyValueDatastore

% May require setting HADOOP_PREFIX or HADOOP_HOME environment variables to a
% valid Hadoop installation folder even if running locally.
% For example:
% setenv('HADOOP_PREFIX','/share/hadoop/hadoop-2.5.2')

inRDD = sc.parallelize({1,2,3,4,5});
redRDD= inputRDD.map(@(x)({x,1})).reduceByKey(@(x,y)(x+y))
% Store RDD in a key-value binary file that can be read back into MATLAB using datastor
redRdd.saveAsKeyValueDatastore('myKVdir')
```

See Also

matlab.compiler.mlspark.RDD.saveAsTallDatastore | matlab.compiler.mlspark.RDD.saveAsTextFile | matlab.compiler.mlspark.SparkContext.parallelize | `datastore`

Introduced in R2016b

saveAsTextFile

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Save RDD as a text file

Syntax

```
saveAsTextFile(obj,path)
```

Description

`saveAsTextFile(obj,path)` saves `obj` as a text file in a location specified by `path`.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a `RDD` object.

`path` — Directory location

character vector

Directory location in which to save the text file, specified as a character vector enclosed in `''`.

Data Types: `char`

Examples

Save an RDD as a Text File

Save an RDD as a text file by converting each RDD element to its string representation and storing it as a line of text.

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% saveAsTextFile

% May require setting HADOOP_PREFIX or HADOOP_HOME environment variables to a
% valid Hadoop installation folder even if running locally.
% For example:
% setenv('HADOOP_PREFIX','/mathworks/AH/hub/apps_PCT/LS_Hadoop_hadoop01glnxa64/hadoop-2

inRDD = sc.parallelize({1,2,3,4,5});
inRDD.saveAsTextFile('myFile.txt');
```

See Also

matlab.compiler.mlspark.RDD.saveAsTallDatastore |
matlab.compiler.mlspark.RDD.saveAsKeyValueDatastore |
matlab.compiler.mlspark.SparkContext.parallelize | `datastore`

Introduced in R2016b

sortBy

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Sort an RDD by a given function

Syntax

```
result = sortBy(obj,func,numPartitions)
```

Description

`result = sortBy(obj,func,numPartitions)` sorts `obj` using a given `func`. `numPartitions` specifies the number of partitions to create in the resulting RDD.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD specified as a `RDD` object.

`func` — Function to compute the sort key for each element

function handle

Function that computes the sort key for each element in the input RDD, specified as a function handle.

Data Types: `function_handle`

`numPartitions` — Number of partitions to create

scalar value

A scalar value specifying the number of partitions to create, returned as a `RDD` object.

Data Types: `double`

Output Arguments

`result` — Output RDD
RDD object

An output pipelined RDD.

Examples

Sort an RDD

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% sortBy
x = sc.parallelize({ {'a', 50}, {'b', 20}, {'f', 40}, {'d', 30}, {'2',5} });
% sort by 2nd element in each key-value pair
z = x.sortBy(@(x)(x{2}));
viewRes = z.collect() % {{'2',5},{'b', 20},{'d', 30},{'f', 40}, {'a', 50}}
```

See Also

matlab.compiler.mlspark.RDD.sortByKey |
matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

sortByKey

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Sort RDD consisting of key-value pairs by key

Syntax

```
result = sortByKey(obj,numPartitions)
```

Description

`result = sortByKey(obj,numPartitions)` sorts a key-value `obj` by key. `numPartitions` specifies the number of partitions to create in the resulting RDD.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a RDD object.

`numPartitions` — Number of partitions to create

scalar value

Number of partitions to create, specified as a scalar value.

Data Types: `double`

Output Arguments

`result` — RDD containing elements sorted by key

RDD object

A pipelined RDD containing elements sorted by key, returned as a RDD object.

Examples

Sort an RDD by Key

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% sortByKey
x = sc.parallelize({ {'a',1}, {'d',3}, {'f', 3} , {'b', 2}, {'e', 9}}, 3);
z = x.sortByKey();
viewRes = z.collect() % {{'a',1},{'b',2},{'d',3},{'e',9},{'f',3}}
```

See Also

matlab.compiler.mlspark.RDD.sortBy |
matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

subtract

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Return the values resulting from the set difference between two RDDs

Syntax

```
result = subtract(obj1,obj2,numPartitions)
```

Description

`result = subtract(obj1,obj2,numPartitions)` returns elements that are the set difference of `obj1` and `obj2`. `numPartitions` specifies the number of partitions to create in the resulting RDD.

Input Arguments

`obj1` — First input RDD

RDD object

An input RDD, specified as a RDD object.

`obj2` — Second input RDD

RDD object

An input RDD, specified as a RDD object.

`numPartitions` — Number of partitions to create

scalar value

Number of partitions to create, specified as a scalar value.

Data Types: `double`

Output Arguments

`result` — RDD containing the set subtraction of the two input RDDs

RDD object

A pipelined RDD containing the set subtraction of the two input RDDs, returned as a RDD object.

Examples

Set Difference of Two RDDs

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% subtract
x = sc.parallelize({ 1,2,3 });
y = sc.parallelize({ 2,4,5 });
c = x.subtract(y,2).collect(); % {1,3}
```

See Also

matlab.compiler.mlspark.RDD.subtractByKey | matlab.compiler.mlspark.RDD.intersection | matlab.compiler.mlspark.RDD.union | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

subtractByKey

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Return key-value pairs resulting from the set difference of keys between two RDDs

Syntax

```
result = subtractByKey(obj1,obj2,numPartitions)
```

Description

`result = subtractByKey(obj1,obj2,numPartitions)` returns a key-value pair RDD `result` resulting from the set difference of keys between `obj1` and `obj2`. `numPartitions` specifies the number of partitions to create in the resulting RDD.

Input Arguments

`obj1` — First input RDD

RDD object

An input RDD, specified as a `RDD` object.

`obj2` — Second input RDD

RDD object

An input RDD, specified as a `RDD` object.

`numPartitions` — Number of partitions to create

scalar value

Number of partitions to create, specified as a scalar value.

Data Types: `double`

Output Arguments

`result` — RDD containing the set difference of keys between two RDDs

RDD object

A pipelined RDD containing the set difference of keys between two RDDs, returned as a RDD object.

Examples

Set Difference of Two RDDs by Key

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% subtractByKey
x = sc.parallelize({ {'a',1}, {'b',4}, {'b',5} , {'a',2} });
y = sc.parallelize({ {'a',3}, {'c',4} });
z = sc.parallelize({ {'a',2}, {'c',4} });
a = x.subtractByKey(y).collect(); % {{'b',4},{'b',5}}
```

See Also

matlab.compiler.mlspark.RDD.subtract |
matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

toDebugString

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Obtain a description of an RDD and its recursive dependencies for debugging

Syntax

```
str = toDebugString(obj)
```

Description

`str = toDebugString(obj)` gets a description of input RDD and its recursive dependencies for debugging purposes.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as an RDD object.

Output Arguments

`str` — Character vector with a description of an RDD

character vector

Description of an RDD and its recursive dependencies for debugging purposes, returned as a character vector.

Data Types: `char`

Examples

Obtain Description of an RDD

Use the `toDebugString` method to get a description of an RDD and its recursive dependencies.

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% toDebugString
myFile = sc.textFile('airlinesmall.csv');
myFile.persist();
myFile.toDebugString()
```

See Also

matlab.compiler.mlspark.RDD.persist |
matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

union

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Return the set union of one RDD with another

Syntax

```
result = union(obj1,obj2)
```

Description

`result = union(obj1,obj2)` returns elements that are the set union of `obj1` and `obj2`.

Input Arguments

`obj1` — First input RDD

RDD object

An input RDD, specified as a RDD object.

`obj2` — Second input RDD

RDD object

An input RDD, specified as a RDD object.

Output Arguments

`result` — RDD containing the set union of the two input RDDs

RDD object

A pipelined RDD containing the set union of the two input RDDs, returned as a RDD object.

Examples

Set Union of Two RDDs

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% union
inRDD = sc.parallelize({'A','B'});
newRDD = inRDD.union(inRDD);  %{'A','B', 'A','B'}
viewRes = newRDD.collect()
```

See Also

matlab.compiler.mlspark.RDD.intersection | matlab.compiler.mlspark.RDD.subtract | matlab.compiler.mlspark.RDD.subtractByKey | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

unpersist

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Mark an RDD as nonpersistent, remove all blocks for it from memory and disk

Syntax

```
unpersist(obj)
```

Description

`unpersist(obj)` marks input RDD object as nonpersistent and removes all blocks for it from memory and disk.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as an RDD object.

Examples

Mark an RDD as Non-persistent

Use the `unpersist` method to mark an RDD as nonpersistent.

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% unpersist
```

```
myFile = sc.textFile('airlinesmall.csv');
myFile.persist();
myFile.unpersist();
```

See Also

matlab.compiler.mlspark.RDD.persist | matlab.compiler.mlspark.SparkContext.textFile | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

values

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Return an RDD with the values of each tuple

Syntax

```
result = values(obj)
```

Description

`result = values(obj)` returns an RDD `result` with the values of each tuple in `obj`.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a RDD object.

Output Arguments

`result` — RDD containing values of each tuple

RDD object

A pipelined RDD containing values of each tuple, returned as a RDD object.

Examples

Return an RDD with the Values of Each Tuple

```
%% Connect to Spark
```

```
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% values
m = sc.parallelize({ {'AA', {5,15} }, {'BB', 200}});
out = m.values().collect(); % { {5,15}, 200 }
```

See Also

matlab.compiler.mlspark.RDD.keys | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

zip

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Zip one RDD with another

Syntax

```
result = zip(obj1,obj2)
```

Description

`result = zip(obj1,obj2)` returns a key-value pair RDD `result`, where the first element in the pair is from `obj1` and second element is from `obj2`. The output RDD `result` has the same number of elements as `obj1`. Both the `obj1` and the `obj2` must have the same length.

Input Arguments

`obj1` — First input RDD

RDD object

An input RDD, specified as a RDD object.

`obj2` — Second input RDD

RDD object

An input RDD, specified as a RDD object.

Output Arguments

`result` — Output RDD zipped from two input RDDs

RDD object

An output RDD zipped from two input RDDs, returned as a RDD object.

Examples

Zip One RDD With Another

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% zip
x = sc.parallelize({'A', 'B', 3});
y = sc.parallelize({1, 2, 'C'});
out = x.zip(y).collect(); % {{'A',1},{'B',2},{3,'C'}}}
```

See Also

matlab.compiler.mlspark.RDD.cartesian | matlab.compiler.mlspark.RDD.zipWithIndex | matlab.compiler.mlspark.RDD.zipWithUniqueId | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

zipWithIndex

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Zip an RDD with its element indices

Syntax

```
result = zipWithIndex(obj)
```

Description

`result = zipWithIndex(obj)` zips an `obj` with its element indices.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a RDD object.

Output Arguments

`result` — Output RDD

RDD object

An output pipelined RDD, returned as a RDD object.

Examples

Zip an RDD With its Element Indices

```
%% Connect to Spark
```

```
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% zipWithIndex
x = sc.parallelize({'a','b','c','d'},3);
out = x.zipWithIndex().collect(); % {{'a',0},{'b',1},{'c',2},{'d',3}}
```

See Also

matlab.compiler.mlspark.RDD.zipWithUniqueId |
matlab.compiler.mlspark.SparkContext.parallelize | zip

Introduced in R2016b

zipWithUniqueId

Class: matlab.compiler.mlspark.RDD
Package: matlab.compiler.mlspark

Zip an RDD with generated unique Long IDs

Syntax

```
result = zipWithUniqueId(obj)
```

Description

`result = zipWithUniqueId(obj)` zips `obj` with generated unique Long IDs.

Input Arguments

`obj` — Input RDD

RDD object

An input RDD, specified as a RDD object.

Output Arguments

`result` — Output RDD

RDD object

An output pipelined RDD, returned as a RDD object.

Examples

Zip an RDD With Unique Long IDs

```
%% Connect to Spark
```

```
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% zipWithUniqueId
x = sc.parallelize({'a','b','c','d','e'},3);
out = x.zipWithUniqueId().collect(); % {{'a',0},{'b',1},{'c',4},{'d',2},{'e',5}}
```

See Also

matlab.compiler.mlspark.RDD.zipWithIndex | matlab.compiler.mlspark.RDD.zip | matlab.compiler.mlspark.SparkContext.parallelize

Introduced in R2016b

3

Methods — SparkContext

addJar

Class: matlab.compiler.mlspark.SparkContext
Package: matlab.compiler.mlspark

Add JAR file dependency for all tasks that need to be executed in a `SparkContext`

Syntax

```
addJar(sc,filePath)
```

Description

`addJar(sc,filePath)` adds a JAR file from a location specified by `filePath` to all tasks that need to be executed in SparkContext `sc`.

Input Arguments

`sc` — SparkContext to use

`SparkContext` object

The SparkContext to use, specified as a `SparkContext` object.

`filePath` — Location of JAR file

character vector

Location of JAR file, specified as a character vector enclosed in `''`.

Data Types: `char`

Examples

Add JAR File

Add a JAR file dependency for all tasks that need to be executed in a `SparkContext`.

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);
%% Add JAR file
sc.addJar('/share/myArchive.jar')
```

Introduced in R2016b

broadcast

Class: matlab.compiler.mlspark.SparkContext
Package: matlab.compiler.mlspark

Broadcast a read-only variable to the cluster

Syntax

```
result = broadcast(sc,value)
```

Description

`result = broadcast(sc,value)` broadcasts a read-only variable `value` to the cluster initialized by SparkContext `sc`.

Input Arguments

`sc` — SparkContext to use

`SparkContext` object

The SparkContext to use, specified as a `SparkContext` object.

`value` — Value to be broadcast

any supported data type

The value to be broadcast, specified as any supported data type.

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64` | `logical` | `char` | `struct` | `table` | `cell` | `function_handle` | `categorical`

Output Arguments

`result` — Broadcast variable

`Broadcast` object

Broadcast variable, returned as a broadcast object with the following properties:

- `id`
- `value`
- `path`

Examples

Broadcast a Variable

Broadcast a read-only variable to the cluster.

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% broadcast
myRdd = sc.parallelize({1,2,3,4,5});
myBroadcast = sc.broadcast('Hello, World');
newRdd = myRdd.map(@(x) myBroadcast.value);
countdata = newRdd.collect()
```

Introduced in R2016b

delete

Class: matlab.compiler.mlspark.SparkContext
Package: matlab.compiler.mlspark

Shutdown connection to Spark enabled cluster

Syntax

```
delete(sc)
```

Description

`delete(sc)` deletes a SparkContext `sc` and shuts down the connection to Spark enabled cluster.

Input Arguments

`sc` — SparkContext to use

`SparkContext` object

The SparkContext to use, specified as a `SparkContext` object.

Examples

Delete a SparkContext

Delete a `SparkContext` object.

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% delete
```

```
delete(sc)
```

Introduced in R2016b

datastoreToRDD

Class: matlab.compiler.mlspark.SparkContext
Package: matlab.compiler.mlspark

Convert MATLAB `datastore` to a Spark RDD

Syntax

```
rdd = datastoreToRDD(sc,ds)
```

Description

`rdd = datastoreToRDD(sc,ds)` converts a MATLAB `datastore` object `ds` to a Spark RDD.

Input Arguments

`sc` — SparkContext to use

`SparkContext` object

The SparkContext to use, specified as a `SparkContext` object.

`ds` — Datastore to be converted

MATLAB `datastore`

Datastore to be converted to an RDD, specified as a MATLAB `datastore` object.

Output Arguments

`rdd` — Output RDD

`RDD` object

Output RDD representing the converted `datastore` object, returned as a `RDD` object.

Examples

Convert MATLAB Datastore to Spark RDD

Convert a MATLAB `datastore` object to a Spark RDD.

```
% Setup Spark Properties as a MATLAB Map object using a containers.Map class
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});

% Create SparkConf object
conf = matlab.compiler.mlspark.SparkConf(...
    'AppName'         , 'myApp', ...
    'Master'          , 'local[1]', ...
    'SparkProperties',  sparkProp );

% Create a SparkContext
sc = matlab.compiler.mlspark.SparkContext(conf);

% Create a MATLAB datastore
ds = datastore('airlinesmall.csv','TreatAsMissing','NA');

% Convert MATLAB datastore to Spark RDD
rdd = datastoreToRDD(sc,ds);

% Alternate object usage:
rdd = sc.datastoreToRDD(ds);
```

Introduced in R2016b

getSparkConf

Class: matlab.compiler.mlspark.SparkContext
Package: matlab.compiler.mlspark

Get `SparkConf` configuration parameters

Syntax

```
conf = getSparkConf(sc)
```

Description

`conf = getSparkConf(sc)` retrieves the `SparkConf` configuration parameters.

Input Arguments

`sc` — SparkContext to use

`SparkContext` object

The SparkContext to use, specified as a `SparkContext` object.

Output Arguments

`conf` — Spark configuration parameters

`SparkConf` object

Spark configuration parameters, returned as a `SparkConf` object with properties.

Examples

Get SparkConf Configuration Parameters

Retrieve the `SparkConf` configuration parameters.

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% getSparkConf
getSparkConf(sc) % Alternate Usage: >> sc.getSparkConf();
```

Introduced in R2016b

parallelize

Class: matlab.compiler.mlspark.SparkContext
Package: matlab.compiler.mlspark

Create an RDD from a collection of local MATLAB values

Syntax

```
rdd = parallelize(sc,cellArray)
rdd = parallelize(sc,cellArray,numSlices)
```

Description

`rdd = parallelize(sc,cellArray)` creates an RDD from a collection of local MATLAB values grouped as a cell array.

`rdd = parallelize(sc,cellArray,numSlices)` creates an RDD with the number of partitions specified by `numSlices`.

Input Arguments

`sc` — SparkContext to use

`SparkContext` object

The SparkContext to use, specified as a `SparkContext` object.

`cellArray` — Collection of values

cell array

A collection of values, specified as a MATLAB cell array.

Data Types: `cell`

`numSlices` — Number of partitions to create

scalar

Number of partitions to create, specified as a scalar.

Data Types: `double`

Output Arguments

`rdd` — Output RDD created from the collection of values

RDD object

An output RDD created from the collection of values, returned as an RDD object.

Examples

Create an RDD From MATLAB Values

Create an RDD from local MATLAB values.

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% parallelize
x = sc.parallelize({1, 2, 3, 4, 5});
y = x.count()
```

Introduced in R2016b

setCheckpointDir

Class: matlab.compiler.mlspark.SparkContext
Package: matlab.compiler.mlspark

Set the directory under which RDDs are to be checkpointed

Syntax

```
setCheckpointDir(sc,dirName)
```

Description

`setCheckpointDir(sc,dirName)` set the directory `dirName` under which RDDs are to be checkpointed.

Input Arguments

`sc` — SparkContext to use

`SparkContext` object

The SparkContext to use, specified as a `SparkContext` object.

`dirName` — Directory where RDDs are to be checkpointed

character vector

Directory where the RDDs are to be checkpointed, specified as a character vector enclosed in `''`.

Data Types: `char`

Examples

Set Checkpoint Directory

Set the directory under which RDDs are to be checkpointed.

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% setCheckpointDir
sc.setCheckpointDir('myDir')
```

Introduced in R2016b

setLogLevel

Class: matlab.compiler.mlspark.SparkContext
Package: matlab.compiler.mlspark

Set log level

Syntax

```
setLogLevel(sc,logLevel)
```

Description

`setLogLevel(sc,logLevel)` sets the log level to one of eight possible options.

Input Arguments

`sc` — SparkContext to use

`SparkContext` object

The SparkContext to use, specified as a `SparkContext` object.

`logLevel` — Log level to set

`'ALL' | 'DEBUG' | 'ERROR' | 'FATAL' | 'INFO' | 'OFF' | 'TRACE' | 'WARN'`

Log level, specified as one of the following values:

- `'ALL'`
- `'DEBUG'`
- `'ERROR'`
- `'FATAL'`
- `'INFO'`
- `'OFF'`
- `'TRACE'`

- `'WARN'`

Data Types: `char`

Examples

Set Log Level

Set the log level for execution against Spark.

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% Set log level
sc.setLogLevel('OFF');
```

Introduced in R2016b

textFile

Class: matlab.compiler.mlspark.SparkContext
Package: matlab.compiler.mlspark

Create an RDD from a text file

Syntax

```
rdd = textFile(sc,pathToFile)
rdd = textFile(sc,pathToFile,minPartitions)
```

Description

`rdd = textFile(sc,pathToFile)` creates an RDD from a text file located in `pathToFile`.

`rdd = textFile(sc,pathToFile,minPartitions)` creates an RDD with minimum partitions specified by `minPartitions`.

Input Arguments

`sc` — SparkContext to use

`SparkContext` object

The SparkContext to use, specified as a `SparkContext` object.

`pathToFile` — File path to text file

character vector

File path to text file, specified as a character vector enclosed in `''`.

Data Types: `char`

`minPartitions` — Minimum number of partitions to be created

scalar

Minimum number of partitions to be created, specified as a scalar.

Data Types: `double`

Output Arguments

`result` — Output RDD created from text file

RDD object

An output RDD created from reading in a text file, returned as an RDD object.

Examples

Create RDD from Text File

```
%% Connect to Spark
sparkProp = containers.Map({'spark.executor.cores'}, {'1'});
conf = matlab.compiler.mlspark.SparkConf('AppName','myApp', ...
                        'Master','local[1]','SparkProperties',sparkProp);
sc = matlab.compiler.mlspark.SparkContext(conf);

%% textFile
rdd = sc.textFile('/<matlabroot>/toolbox/matlab/demos/airlinesmall.csv')
```

Introduced in R2016b

4

Apache Spark Basics

Apache Spark Basics

In this section...

Apache Spark is a fast, general-purpose engine for large-scale data processing.

Every Spark application consists of a *driver* program that manages the execution of your application on a cluster. The workers on a Spark enabled cluster are referred to as *executors*. The driver process runs the user code on these executors.

In a typical Spark application, your code will establish a *SparkContext*, create a *Resilient Distributed Dataset* (*RDD*) from external data, and then execute methods known as *transformations* and *actions* on that RDD to arrive at the outcome of an analysis.

An RDD is the main programming abstraction in Spark and represents an immutable collection of elements partitioned across the nodes of a cluster that can be operated on in parallel. A Spark application can run locally on a single machine or on a cluster.

Spark is mainly written in Scala and has APIs in other programming languages, including MATLAB. The MATLAB API for Spark exposes the Spark programing model to MATLAB and enables MATLAB implementations of numerous Spark functions. Many of these MATLAB implementations of Spark functions accept function handles or anonymous functions as inputs to perform various types of analyses.

Running against Spark

To run against Spark means executing an application against a Spark enabled cluster using a supported cluster manager. A cluster can be local or on a network. You can run against Spark in two ways:

- Execute commands in an *interactive shell* that is connected to Spark.
- Create and execute a *standalone application* against a Spark cluster.

When using an interactive shell, Spark allows you to interact with data that is distributed on disk or in memory across many machines and perform ad-hoc analysis. Spark takes care of the underlying distribution of work across various machines. Interactive shells are only available in Python® and Scala.

The MATLAB API for Spark in MATLAB Compiler™ provides an interactive shell similar to a Spark shell that allows you to debug your application prior to deploying it. The interactive shell only runs against a local cluster.

When creating and executing standalone applications against Spark, applications are first packaged or compiled as standalone applications before being executed against a Spark enabled cluster. You can author standalone applications in Scala, Java®, Python, and MATLAB.

The MATLAB API for Spark in MATLAB Compiler lets you to create standalone applications that can run against Spark.

Cluster Managers Supported by Spark

Local

A *local* cluster manager represents a pseudo-cluster and works in a nondistributed mode on a single machine. You can configure it to use one worker thread, or on a multicore machine, multiple worker threads. In applications, it is denoted by the word `local`.

Note: The MATLAB API for Spark, which allows you to interactively debug your applications, works only with a local cluster manager.

Standalone

A *Standalone* cluster manager ships with Spark. It consists of a master and multiple workers. To use a Standalone cluster manager, place a compiled version of Spark on each cluster node. A Standalone cluster manager can be launched using scripts provided by Spark. In applications, it is denoted as: `spark://host:port`. The default port number is `7077`.

Note: The Standalone cluster manager that ships with Spark is not to be confused with the *standalone application* that can run against Spark. MATLAB Compiler does not support the Standalone cluster manager.

YARN

A YARN cluster manager was introduced in Hadoop 2.0. It is typically installed on the same nodes as HDFS. Therefore, running Spark on YARN lets Spark access HDFS data easily. In applications, it is denoted using the term `yarn`. There are two modes that are available when launching applications on YARN:

- In `yarn-client` mode, the driver runs in the client process, and the application master is used only for requesting resources from YARN.
- In `yarn-cluster` mode, the Spark driver runs inside an application master process that is managed by YARN on the cluster, and the client can retire after initiating the application.

Note: MATLAB Compiler supports the YARN cluster manager only in `yarn-client` mode.

Mesos

A Mesos cluster manager is an open-source cluster manager developed by Apache™. In applications, it is usually denoted as: `mesos://host:port`. The default port number is `5050`.

Note: MATLAB Compiler does not support a Mesos cluster manager.

You can use the following table to see which MATLAB Compiler deployment option is supported by each cluster manager.

Deploy Against Spark Option	Local Cluster (`local`)	Hadoop Cluster (`yarn-client`)
Deploy standalone applications containing tall arrays on page 6-2.	Not supported.	Supported.
Deploy standalone applications created using the MATLAB API for Spark on page 7-2.	Supported.	Supported.
Interactively debug your applications using the MATLAB API for Spark on page 7-2.	Supported.	Not supported.

Relationship Between Spark and Hadoop

The relationship between Spark and Hadoop comes into play only if you want to run Spark on a cluster that has Hadoop installed. Otherwise, you do not need Hadoop to run Spark.

To run Spark on a cluster you need a shared file system. A Hadoop cluster provides access to a distributed file-system via HDFS and a cluster manager in the form of YARN. Spark can use YARN as a cluster manager for distributing work and use HDFS to access data. Also, some Spark applications can use Hadoop's MapReduce programming model, but MapReduce does not constitute the core programming model in Spark.

Hadoop is not required to run Spark on cluster. You can also use other options such as Mesos.

Note: The deployment options in MATLAB Compiler currently support deploying only against a Spark enabled Hadoop cluster.

Driver

Every Spark application consists of a *driver* program that initiates various operations on a cluster. The driver is a process in which the `main()` method of a program runs. The driver process runs user code that creates a SparkContext, creates RDDs, and performs transformations and actions. When a Spark driver executes, it performs two duties:

- Convert a user program into tasks.

  The Spark driver application is responsible for converting a user program into units of physical execution called tasks. Tasks are the smallest unit of work in Spark.

- Schedule tasks on executors.

  The Spark driver tries to schedule each task in an appropriate location, based on data placement. It also tracks the location of cached data, and uses it to schedule future tasks that access that data.

Once the driver terminates, the application is finished.

Note: When using the MATLAB API for Spark in MATLAB Compiler, MATLAB application code becomes the Spark driver program.

Executor

A Spark executor is a worker process responsible for running the individual tasks in a given Spark job. Executors are launched at the beginning of a Spark application and persist for the entire lifetime of an application. Executors perform two roles:

- Run the tasks that make up the application, and return the results to the driver.
- Provide in-memory storage for RDDs that are cached by user programs.

RDD

A *Resilient Distributed Dataset* or *RDD* is a programming abstraction in Spark. It represents a collection of elements distributed across many nodes that can be operated in parallel. RDDs tend to be fault-tolerant. You can create RDDs in two ways:

- By loading an external dataset.

- By parallelizing a collection of objects in the *driver* on page 4-6 program.

After creation, you can perform two types of operations using RDDs: *transformations* and *actions*.

Transformations

Transformations are operations on an existing RDD that return a new RDD. Many, but not all, transformations are elementwise operations.

Actions

Actions compute a final result based on an RDD and either return that result to the driver program or save it to an external storage system such as HDFS.

Distinguishing Between Transformations and Actions

Check the return data type. Transformations return RDDs, whereas actions return other data types.

SparkConf

SparkConf stores the configuration parameters of the application being deployed to Spark. Every application needs to be configured prior to being deployed on a Spark cluster. Some of the configuration parameters define properties of the application and some are used by Spark to allocate resources on the cluster. The configuration parameters are passed onto a Spark cluster through a `SparkContext`.

SparkContext

A *SparkContext* represents a connection to a Spark cluster. It is the entry point to Spark and sets up the internal services necessary to establish a connection to the Spark execution environment.

5

Configure MATLAB Environment for Spark Deployment

Configure MATLAB Environment for Spark Deployment

Before you create a MATLAB application for deployment against Spark, you must configure your MATLAB environment by adding the following information to the front of MATLAB's static Java class path:

- Location of the Spark assembly jar.
- Location of Hadoop configuration files.

A Spark assembly JAR file includes all the Spark dependencies, including some internal Hadoop dependencies. The JAR file created during Spark installation is specific to a particular combination of Spark and Hadoop versions. For example, using Spark version 1.6.0 and Hadoop version 2.6.0 creates the file `spark-assembly-1.6.0-hadoop2.6.0.jar`.

If you plan on deploying your standalone application on a Spark enabled Hadoop cluster, then you need to include the location of the Hadoop configuration files. The Hadoop configuration files are usually located in the `<hadooproot>/etc/hadoop` folder.

For more information about the relationship between Spark and Hadoop, see "Relationship Between Spark and Hadoop" on page 4-5.

To add the location of the Spark assembly jar and the location of the Hadoop configuration files to the front of MATLAB's static Java class path, use the following procedure:

1. Create an ASCII text file in your work folder and name the file `javaclasspath.txt`.
2. Enter the tag `<before>` on a single line. On the next line enter the location of the Spark assembly JAR file. On the line after that, enter the location of Hadoop configuration files. For example:

```
<before>
/share/spark/lib/spark-assembly-1.6.0-hadoop2.6.0.jar
## Optional: Uncomment next line only if deploying against Spark enabled Hadoop clu
#/share/hadoop/hadoop-2.6.0/etc/hadoop
```

   By default, comment out the location of the Hadoop configuration files using #. You can uncomment this line only if you need to deploy to a Spark enabled Hadoop cluster.

The `<before>` tag ensures that `spark-assembly-1.6.0-hadoop2.6.0.jar` is added to the front of the Java class path.

3 Start MATLAB from the folder containing the `javaclasspath.txt` file.

You can verify whether `spark-assembly-1.6.0-hadoop2.6.0.jar` was added to the front of the Java class path by typing the following at the MATLAB command prompt:

```
>> spath = javaclasspath('-static') ;
>> spath(1)
```

You should see `/share/spark/lib/spark-assembly-1.6.0-hadoop2.6.0.jar` on the top of the list.

You need to complete this setup one time. Subsequent usage requires only that you start MATLAB from the folder containing the `javaclasspath.txt` file. And if you are deploying your application to a Spark enabled Hadoop cluster, then uncomment the line that includes the location of the Hadoop configuration files.

You can use the following table to decide when to include the location of the Spark assembly jar and Hadoop configuration files in your `javaclasspath.txt` file.

Deploy Against Spark Option	Local Cluster (`local`)	Hadoop Cluster (`yarn-client`)
Deploy standalone applications containing tall arrays.	Not supported. Location of Spark assembly jar: **Not applicable**. Location of Hadoop configuration files: **Not applicable**.	Supported. Location of Spark assembly jar: **Required**. Location of Hadoop configuration files: **Required**.
Deploy standalone applications created using the MATLAB API for Spark.	Supported. Location of Spark assembly jar: **Required**. Location of Hadoop configuration files: **Not required**.	Supported. Location of Spark assembly jar: **Required**. Location of Hadoop configuration files: **Required**.

Deploy Against Spark Option	Local Cluster (`local`)	Hadoop Cluster (`yarn-client`)
Interactively debug your applications using the MATLAB API for Spark.	Supported. Location of Spark assembly jar: **Required**. Location of Hadoop configuration files: **Not required**.	Not supported. Location of Spark assembly jar: **Not applicable**. Location of Hadoop configuration files: **Not applicable**.

Note: If you are using Spark version 1.6 or higher, you will need to increase the Java heap size in MATLAB to at least 512MB. For information on how to increase the Java heap size in MATLAB, see "Java Heap Memory Preferences".

Supported Platform: Linux® only.

Supported Spark Versions:1.3–1.6

6

Deploy Tall Arrays to a Spark enabled Hadoop Cluster

Example on Deploying Tall Arrays to a Spark Enabled Hadoop Cluster

This example shows how to deploy a MATLAB application containing tall arrays to a Spark enabled Hadoop cluster.

This example uses the airline dataset, `airlinesmall.csv`, which contains departure and arrival information about individual airline flights. The goal of this example is to compute the mean arrival delay and the biggest departure delays of the airlines. The dataset is available in the `<matlabroot>/toolbox/matlab/demos` folder.

Supported Platform: Linux only.

Supported Apache Spark Versions:1.3–1.6

Note: Prior to creating and packaging your application, it is necessary to configure your MATLAB environment for deployment. See Configure MATLAB Environment for Spark Deployment for more information on how to configure your MATLAB environment.

Prerequisites

- Start this example by creating a new work folder that is visible to the MATLAB search path.
- Check to see if you have configured MATLAB environment for Spark deployment. For more information, see “Configure MATLAB Environment for Spark Deployment” on page 5-2.
- Uncomment the line containing the folder location of the Hadoop configuration files in the file `javaclasspath.txt`. For example, your `javaclasspath.txt` file should look like this:

```
<before>
/share/spark/lib/spark-assembly-1.6.0-hadoop2.6.0.jar
/share/hadoop/hadoop-2.6.0/etc/hadoop
```

  The paths in the above `javaclasspath.txt` file need to point to locations on your network.

The file `javaclasspath.txt` is created as part of configuring your MATLAB environment for Spark deployment.

- Copy the file `javaclasspath.txt` to your newly created work folder.
- Install the MATLAB Runtime in a folder that is accessible by every worker node in the Hadoop cluster. This example uses `/share/MATLAB/MATLAB_Runtime/v91` as the location of the MATLAB Runtime folder.

  If you don't have the MATLAB Runtime, you can download it from the website at: http://www.mathworks.com/products/compiler/mcr.
- Copy the `airlinesmall.csv` into Hadoop Distributed File System (HDFS) folder `/user/<username>/datasets`. Here `<username>` refers to your user name in HDFS.

```
$ ./hadoop fs -copyFromLocal airlinesmall.csv hdfs://hadoopfs:54310/user/<username>
```

Procedure

1. Set up the environment variable, `HADOOP_PREFIX` to point at your Hadoop install folder. These properties are necessary for submitting jobs to your Hadoop cluster.

   ```
   setenv('HADOOP_PREFIX','/share/hadoop/hadoop-2.6.0')
   ```

   The `HADOOP_PREFIX` environment variable needs to be set when using the MATLAB `datastore` function to point to data on HDFS. Setting this environment variable has nothing to do with Spark. See "Relationship Between Spark and Hadoop" on page 4-5 for more information.

   If you plan on using a dataset that's on your local machine as opposed to one on HDFS, then you can skip this step.
2. Specify Spark properties.

   Use a containers.Map object to specify Spark properties.

   ```
   sparkProperties = containers.Map( ...
    {'spark.executor.cores', ...
    'spark.executor.memory', ...
    'spark.yarn.executor.memoryOverhead', ...
    'spark.dynamicAllocation.enabled', ...
    'spark.shuffle.service.enabled', ...
    'spark.eventLog.enabled', ...
    'spark.eventLog.dir'}, ...
    {'1', ...
   ```

```
    '2g', ...
    '1024', ...
    'true', ...
    'true', ...
    'true', ...
    'hdfs://hadoopfs:54310/user/<username>/sparkdeploy'});
```

For more information on Spark properties, expand the `prop` value of the `'SparkProperties'` name-value pair in the section of the `SparkConf` class. The `SparkConf` class is part of the MATLAB API for Spark, which provides an alternate way to deploy MATLAB applications to Spark. For more information, see "Deploy Applications Using the MATLAB API for Spark".

3 Configure your MATLAB application containing tall arrays with Spark parameters.

Use the class matlab.mapreduce.DeploySparkMapReducer to configure your MATLAB application containing tall arrays with Spark parameters as key-value pairs.

```
conf = matlab.mapreduce.DeploySparkMapReducer( ...
      'AppName','myTallApp', ...
      'Master','yarn-client', ...
      'SparkProperties',sparkProperties);
```

For more information, see matlab.mapreduce.DeploySparkMapReducer.

4 Define the Spark execution environment.

Use the `mapreducer` function to define the Spark execution environment.

```
mapreducer(conf)
```

For more information, see `mapreducer`.

5 Include your MATLAB application code containing tall arrays.

Use the MATLAB function `datastore` to create a `datastore` object pointing to the file `airlinesmall.csv` in HDFS. Pass the `datastore` object as an input argument to the `tall` function. This will create a tall array. You can perform operations on the tall array to compute the mean delay and biggest departure delays.

```
% Create a |datastore| for a collection of tabular text files representing airline
% Select the variables of interest, specify a categorical data type for the
% |Origin| and |Dest| variables.
% ds = datastore('airlinesmall.csv') % if using a dataset on your local machine
ds = datastore('hdfs://hadoopfs:54310/user/<username>/datasets/airlinesmall.csv');
```

```
ds.TreatAsMissing = 'NA';
ds.SelectedVariableNames = {'Year','Month','ArrDelay','DepDelay','Origin','Dest'};
ds.SelectedFormats(5:6) = {'%C','%C'};

% Create Tall Array
% Tall arrays are like normal MATLAB arrays, except that they can have any
% number of rows. When a |tall| array is backed by a |datastore|, the underlying cl
% the tall array is based on the type of datastore.
tt = tall(ds);

% Remove Rows with Missing Data or NaN Values
idx = any(ismissing(tt),2);
tt(idx,:) = [];

% Compute Mean Delay
mnDelay = mean(tt.DepDelay,'omitnan');
biggestDelays = topkrows(tt,10,'DepDelay');

% Gather Results
% The |gather| function forces evaluation of all queued operations and
% brings the resulting output back into memory.
[mnDelay,biggestDelays] = gather(mnDelay,biggestDelays)

% Delete mapreducer object
delete(conf);
```

6 Create a standalone application.

Use the `mcc` command with the `-m` flag to create a standalone application. The `-m` flag creates a standard executable that can be run from a command line.

```
>> mcc -m deployTallArrayToSpark.m
```

The `mcc` command creates a shell script `run_deployTallArrayToSpark.sh` to run the executable file `deployTallArrayToSpark`.

For more information, see `mcc`.

7 Run the standalone application from a Linux shell using the following command:

```
$ ./run_deployTallArrayToSpark.sh /share/MATLAB/MATLAB_Runtime/v91
```

`/share/MATLAB/MATLAB_Runtime/v91` is an argument indicating the location of the MATLAB Runtime.

Prior to executing the above command, make sure the `javaclasspath.txt` file is in the same folder as the shell script and the executable.

Your application will fail to execute if it cannot find the file `javaclasspath.txt`.

Your application may also fail to execute if the optional line containing the folder location of the Hadoop configuration files is commented.

8 You will see the following output:

```
mnDelay =
    8.1310

biggestDelays =

    Year    Month    ArrDelay    DepDelay    Origin    Dest
    ____    _____    ________    ________    ______    ____

    1991      3         -8        1438        MCO       BWI
    1998     12        -12        1433        CVG       ORF
    1995     11       1014        1014        HNL       LAX
    2007      4        914         924        JFK       DTW
    2001      4        887         884        MCO       DTW
    2008      7        845         855        CMH       ORD
    1988      3        772         785        ORD       LEX
    2008      4        710         713        EWR       RDU
    1998     10        679         673        MCI       DFW
    2006      6        603         626        ABQ       PHX
```

Optionally, if you want to analyze or view the results generated by your application in MATLAB, you need to write the results to a file on HDFS using the `write` function for tall arrays. You can then read the file using the `datastore` function.

In order to write the results to file on HDFS, add the following line of code to your MATLAB application just before the `delete(conf)` statement and then package your application:

```
write('hdfs://hadoopfs:54310/user/<username>/results', tall(biggestDelays));
```

Replace `<username>` with your user name.

You can only save one variable to a file using the `write` function for tall arrays. Therefore, you will need to write to multiple files if you want to save multiple variables.

In order to view the results in MATLAB after executing the application against a Spark enabled cluster, use the `datastore` function as follows:

```
>> ds = datastore(hdfs://hadoopfs:54310/user/username/results')
>> ds.readall
```

You may need to set the environment variable `HADOOP_PREFIX` using the function `setenv` in case you are unable to view the results using the `datastore` function.

7

Deploy MATLAB Applications to Spark using the MATLAB API for Spark

Example on Deploying Applications to Spark Using the MATLAB API for Spark

This example shows you how to deploy a standalone application to Spark using the MATLAB API for Spark. Your application can be deployed against Spark using one of two supported cluster managers: local and Hadoop YARN. This example shows you how to deploy your application using both cluster managers. For a discussion on cluster managers, see “Cluster Managers Supported by Spark” on page 4-3.

In this section...

This example uses the airline dataset, `airlinesmall.csv`, which contains departure and arrival information about individual airline flights. The goal of this example is to count the number of unique airline carriers in the dataset. The dataset is available in the `<matlabroot>/toolbox/matlab/demos` folder.

Start this example by creating a new work folder that is visible to the MATLAB search path.

Create a MATLAB file named `carrierToCount.m` with the following code:

```
function results = carrierToCount(input)
    tbl = input{1};
    intermKeys = tbl.UniqueCarrier;
    [intermKeys, ~, idx] = unique(intermKeys);
    intermValues = num2cell(accumarray(idx, ones(size(idx))));
    results = cellfun( @(x,y) {x,y} , ...
        intermKeys, intermValues, ...
        'UniformOutput',false);
```

This helper function is passed in as a function handle to one of the methods in the example.

Supported Platform: Linux only.

Supported Apache Spark Versions:1.3–1.6

Note: Prior to creating and packaging your application, it is necessary to configure your MATLAB environment for Spark deployment. See Configure MATLAB Environment for Spark Deployment for more information on how to configure your MATLAB environment.

Local

A local cluster manager represents a pseudo Spark enabled cluster and works in a non-distributed mode on a single machine. It can be configured to use one worker thread, or on a multi-core machine, multiple worker threads. In applications, it is denoted by the word `local`. A local cluster manager is handy for debugging your application prior to full blown deployment on a Spark enabled Hadoop cluster.

Prerequisites

- Start this example by creating a new work folder that is visible to the MATLAB search path.
- Check to see if you have configured your MATLAB environment for Spark deployment. For more information, see "Configure MATLAB Environment for Spark Deployment" on page 5-2.
- Verify that the optional line containing the folder location of the Hadoop configuration files is commented out using # in the file `javaclasspath.txt`. The file `javaclasspath.txt` is created as part of configuring your MATLAB environment for Spark deployment.
- Copy the file `javaclasspath.txt` to your newly created work folder.

Procedure

1 Specify Spark properties.

Use a containers.Map object to specify Spark properties.

```
sparkProp = containers.Map(...
    {'spark.executor.cores',...
    'spark.matlab.worker.debug'},...
    {'1',...
    'true'});
```

Spark properties indicate the Spark execution environment of the application that is being deployed. Every application needs to be configured with specific Spark properties in order for it to be deployed.

For more information on Spark properties, expand the `prop` value of the `'SparkProperties'` name-value pair in the section of the `SparkConf` class .

2 Create a `SparkConf` object.

Use the class `matlab.compiler.mlspark.SparkConf` to create a `SparkConf` object. A `SparkConf` object stores the configuration parameters of the application being deployed to Spark. The configuration parameters of an application are passed onto a Spark cluster through a SparkContext.

```
conf = matlab.compiler.mlspark.SparkConf(...
    'AppName', 'mySparkAppDepLocal', ...
    'Master', 'local[1]', ...
    'SparkProperties', sparkProp );
```

For more information on SparkConf, see `matlab.compiler.mlspark.SparkConf`.

3 Create a `SparkContext` object.

Use the class `matlab.compiler.mlspark.SparkContext` with the `SparkConf` object as an input to create a `SparkContext` object.

```
sc = matlab.compiler.mlspark.SparkContext(conf);
```

A `SparkContext` object serves as an entry point to Spark by initializing a connection to a Spark cluster. It accepts a `SparkConf` object as an input argument and uses the parameters specified in that object to set up the internal services necessary to establish a connection to the Spark execution environment.

For more information on SparkContext, see `matlab.compiler.mlspark.SparkContext`.

4 Create an `RDD` object from the data.

Use the MATLAB function `datastore` to create a `datastore` object pointing to the file `airlinesmall.csv`. Then use the SparkContext method `datastoreToRDD` to convert the `datastore` object to a Spark `RDD` object.

```
% Create a MATLAB datastore (LOCAL)
ds = datastore('airlinesmall.csv',...
    'TreatAsMissing','NA', ...
    'SelectedVariableNames','UniqueCarrier');
% Convert MATLAB datastore to Spark RDD
rdd = sc.datastoreToRDD(ds);
```

In general, input RDDs can be created using the following methods of the `SparkContext` class: `parallelize` on page 3-12, `datastoreToRDD` on page 3-8, and `textFile` on page 3-18.

5 Perform operations on the `RDD` object.

Use a Spark RDD method such as `flatMap` on page 2-30 to apply a function to all elements of the `RDD` object and flatten the results. The function `carrierToCount` that was created earlier serves as the function that is going to be applied to the elements of the RDD. A function handle to the function `carrierToCount` is passed as an input argument to the `flatMap` method.

```
maprdd = rdd.flatMap(@carrierToCount);
redrdd = maprdd.reduceByKey( @(acc,value) acc+value );
countdata = redrdd.collect();

% Count and display carrier occurrences
count = 0;
for i=1:numel(countdata)
    count = count + out{i}{2};
    fprintf('\nCarrier Name: %s, Count: %d', countdata{i}{1}, countdata{i}{2});
end
fprintf('\n Total count : %d\n', count);

% Delete Spark Context
delete(sc)
```

In general, you will provide MATLAB functions handles or anonymous functions as input arguments to Spark RDD methods known as *transformations* and *actions*. These function handles and anonymous functions are executed on the workers of the deployed application.

For a list of supported RDD transformations and actions, see "Transformations" on page 1-3 and "Actions" on page 1-3 in the Methods section of the `RDD` class.

For more information on transformations and actions, see "Apache Spark Basics" on page 4-2.

6 Create a standalone application.

Use the `mcc` command with the `-m` flag to create a standalone application. The `-m` flag creates a standard executable that can be run from a command line. The `-a` flag includes the dependent dataset `airlinesmall.csv` from the folder

`<matlabroot>/toolbox/matlab/demos`. The `mcc` command automatically picks up the dependent file `carrierToCount.m` as long as it is in the same work folder.

```
>> mcc -m deployToSparkMlApiLocal.m -a <matlabroot>/toolbox/matlab/demos/airlinesma
```

The `mcc` command creates a shell script `run_deployToSparkMlApiLocal.sh` to run the executable file `deployToSparkMlApiLocal`.

For more information, see `mcc`.

7 Run the standalone application from a Linux shell using the following command:

```
$ ./run_deployToSparkMlApiLocal.sh /share/MATLAB/MATLAB_Runtime/v91
```

`/share/MATLAB/MATLAB_Runtime/v91` is an argument indicating the location of the MATLAB Runtime.

Prior to executing the above command, make sure the `javaclasspath.txt` file is in the same folder as the shell script and the executable.

Your application will fail to execute if it cannot find the file `javaclasspath.txt`.

Your application may also fail to execute if the optional line containing the folder location of the Hadoop configuration files is uncommented. To execute your application on the `local` cluster manager, this line needs to be commented. This line should only be uncommented if you plan on running your application using `yarn-client` as your cluster manager on a Spark enabled Hadoop cluster.

8 You will see the following output:

```
Carrier Name: 9E, Count: 521
Carrier Name: AA, Count: 14930
Carrier Name: AQ, Count: 154
Carrier Name: AS, Count: 2910
Carrier Name: B6, Count: 806
Carrier Name: CO, Count: 8138
...
...
...
Carrier Name: US, Count: 13997
Carrier Name: WN, Count: 15931
Carrier Name: XE, Count: 2357
Carrier Name: YV, Count: 849
 Total count : 123523
```

Hadoop YARN

A yarn-client cluster manager represents a Spark enabled Hadoop cluster. A YARN cluster manager was introduced in Hadoop 2.0. It is typically installed on the same nodes as HDFS. Therefore, running Spark on YARN lets Spark access HDFS data easily. In applications, it is denoted using the word `yarn-client`.

Since the steps for deploying your application using `yarn-client` as your cluster manager are similar to using the local cluster manager shown above, the steps are presented with minimal discussion. For a detailed discussion of each step, check the "Local" on page 7-3 case above.

Prerequisites

- Start this example by creating a new work folder that is visible to the MATLAB search path.
- Check to see if you have configured MATLAB environment for Spark deployment. For more information, see "Configure MATLAB Environment for Spark Deployment" on page 5-2.
- Uncomment the line containing the folder location of the Hadoop configuration files in the file `javaclasspath.txt`. The file `javaclasspath.txt` is created as part of configuring your MATLAB environment for Spark deployment.
- Copy the file `javaclasspath.txt` to your newly created work folder.
- Install the MATLAB Runtime in a folder that is accessible by every worker node in the Hadoop cluster. This example uses `/share/MATLAB/MATLAB_Runtime/v91` as the location of the MATLAB Runtime folder.

  If you don't have the MATLAB Runtime, you can download it from the website at: http://www.mathworks.com/products/compiler/mcr.
- Copy the `airlinesmall.csv` into Hadoop Distributed File System (HDFS) folder `/user/<username>/datasets`. Here `<username>` refers to your username in HDFS.

```
$ ./hadoop fs -copyFromLocal airlinesmall.csv hdfs://hadoopfs:54310/user/<username>
```

Procedure

1. Set up the environment variable, `HADOOP_PREFIX` to point at your Hadoop install folder. These properties are necessary for submitting jobs to your Hadoop cluster.

```
setenv('HADOOP_PREFIX','/share/hadoop/hadoop-2.6.0')
```

The `HADOOP_PREFIX` environment variable needs to be set when using the MATLAB `datastore` function to point to data on HDFS. Setting this environment variable has nothing to do with Spark. See "Relationship Between Spark and Hadoop" on page 4-5 for more information.

2 Specify Spark properties.

Use a containers.Map object to specify Spark properties.

```
sparkProperties = containers.Map( ...
    {'spark.executor.cores',...
    'spark.executor.memory',...
    'spark.yarn.executor.memoryOverhead',...
    'spark.dynamicAllocation.enabled',...
    'spark.shuffle.service.enabled',...
    'spark.eventLog.enabled',...
    'spark.eventLog.dir'}, ...
    {'1',...
    '2g',...
    '1024',...
    'true',...
    'true',...
    'true',...
    'hdfs://hadoop01glnxa64:54310/user/<username>/sparkdeploy'});
```

For more information on Spark properties, expand the `prop` value of the `'SparkProperties'` name-value pair in the section of the `SparkConf` class .

3 Create a `SparkConf` object.

Use the class `matlab.compiler.mlspark.SparkConf` to create a `SparkConf` object.

```
conf = matlab.compiler.mlspark.SparkConf( ...
    'AppName','myApp', ...
    'Master','yarn-client', ...
    'SparkProperties',sparkProperties);
```

For more information on SparkConf, see `matlab.compiler.mlspark.SparkConf`.

4 Create a `SparkContext` object.

Use the class `matlab.compiler.mlspark.SparkContext` with the `SparkConf` object as an input to create a `SparkContext` object.

```
sc = matlab.compiler.mlspark.SparkContext(conf);
```

For more information on SparkContext, see `matlab.compiler.mlspark.SparkContext`.

5 Create an `RDD` object from the data.

Use the MATLAB function `datastore` to create a `datastore` object pointing to the file `airlinesmall.csv` in HDFS. Then use the SparkContext method `datastoreToRDD` to convert the `datastore` object to a Spark `RDD` object.

```
% Create a MATLAB datastore (HADOOP)
ds = datastore(...
    'hdfs://hadoopfs:54310/user/<username>/datasets/airlinesmall.csv',...
    'TreatAsMissing','NA',...
    'SelectedVariableNames','UniqueCarrier');

% Convert MATLAB datastore to Spark RDD
rdd = sc.datastoreToRDD(ds);
```

In general, input RDDs can be created using the following methods of the `SparkContext` class: `parallelize` on page 3-12, `datastoreToRDD` on page 3-8, and `textFile` on page 3-18.

6 Perform operations on the `RDD` object.

Use a Spark RDD method such as `flatMap` on page 2-30 to apply a function to all elements of the `RDD` object and flatten the results. The function `carrierToCount` that was created earlier serves as the function that is going to be applied to the elements of the RDD. A function handle to the function `carrierToCount` is passed as an input argument to the `flatMap` method.

```
maprdd = rdd.flatMap(@carrierToCount);
redrdd = maprdd.reduceByKey( @(acc,value) acc+value );
countdata = redrdd.collect();

% Count and display carrier occurrences
count = 0;
for i=1:numel(countdata)
    count = count + countdata{i}{2};
    fprintf('\nCarrier Code: %s, Count: %d', countdata{i}{1}, countdata{i}{2});
end
fprintf('\n Total count : %d\n', count);
```

```
% Save results to MAT file
save('countdata.mat','countdata');

% Delete Spark Context
delete(sc);
```

For a list of supported RDD transformations and actions, see "Transformations" on page 1-3 and "Actions" on page 1-3 in the Methods section of the `RDD` class.

For more information on transformations and actions, see "Apache Spark Basics" on page 4-2.

7 Create a standalone application.

Use the `mcc` command with the `-m` flag to create a standalone application. The `-m` flag creates a standalone application that can be run from a command line. You do not need to attach the dataset `airlinesmall.csv` since it resides on HDFS. The `mcc` command automatically picks up the dependent file `carrierToCount.m` as long as it is in the same work folder.

```
>> mcc -m deployToSparkMlApiHadoop.m
```

The `mcc` command creates a shell script `run_deployToSparkMlApiHadoop.sh` to run the executable file `deployToSparkMlApiHadoop`.

For more information, see `mcc`.

8 Run the standalone application from a Linux shell using the following command:

```
$ ./run_deployToSparkMlApiHadoop.sh /share/MATLAB/MATLAB_Runtime/v91
```

`/share/MATLAB/MATLAB_Runtime/v91` is an argument indicating the location of the MATLAB Runtime.

Prior to executing the above command, make sure the `javaclasspath.txt` file is in the same folder as the shell script and the executable.

Your application will fail to execute if it cannot find the file `javaclasspath.txt`.

Your application may also fail to execute if the optional line containing the folder location of the Hadoop configuration files is commented. To execute your application on a yarn-client cluster manager, this line needs to be uncommented. This line should only be commented if you plan on running your application using a local cluster manager.

9 You will see the following output:

```
Carrier Name: 9E, Count: 521
Carrier Name: AA, Count: 14930
Carrier Name: AQ, Count: 154
Carrier Name: AS, Count: 2910
Carrier Name: B6, Count: 806
Carrier Name: CO, Count: 8138
...
...
...
Carrier Name: US, Count: 13997
Carrier Name: WN, Count: 15931
Carrier Name: XE, Count: 2357
Carrier Name: YV, Count: 849
 Total count : 123523
```