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Master in Fundamental Principles of Data Science

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combineByKey vs groupByKey vs reduceByKey

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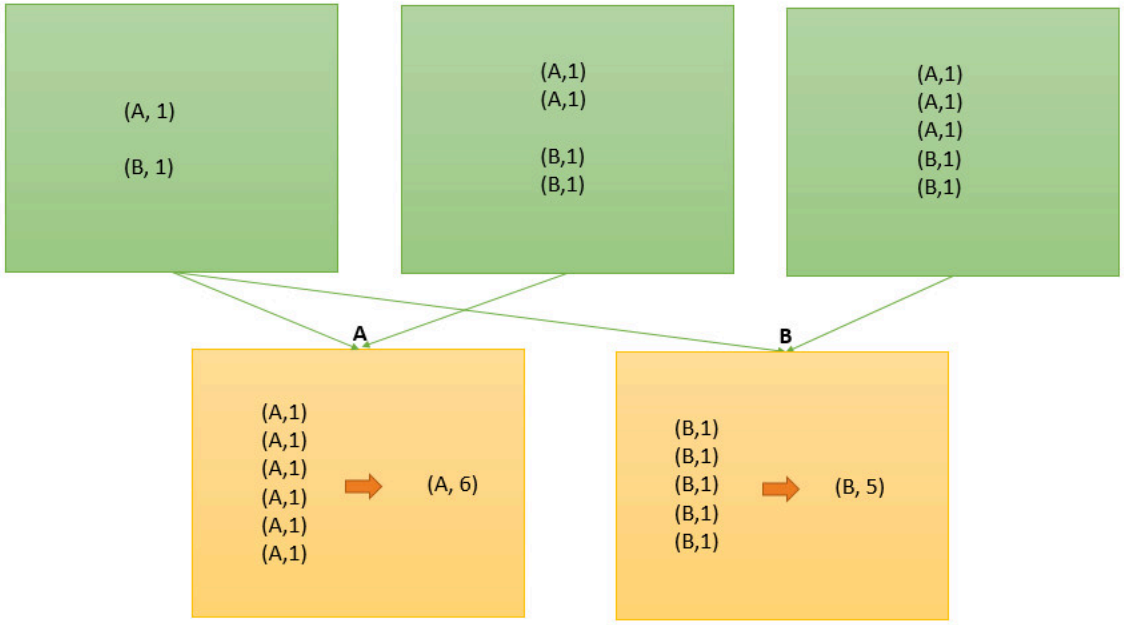
groupByKey

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



http://spark.apache.org/docs/latest/api/python/pyspark.html#pyspark.RDD.groupByKey

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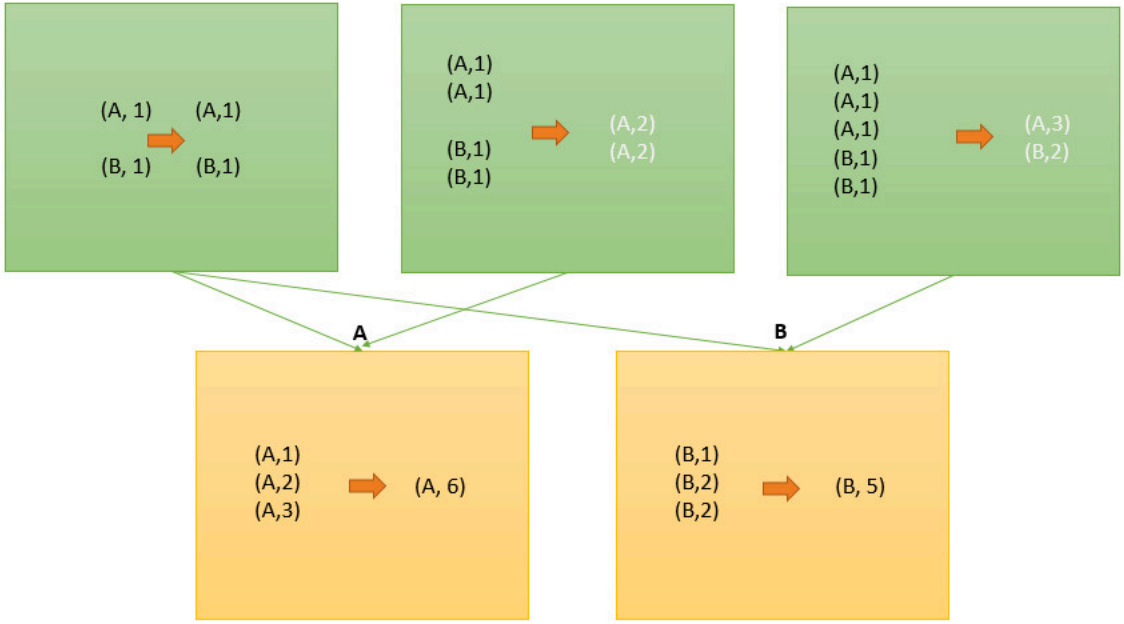
reduceByKey

Merge the values for each key using an associative and commutative reduce function.



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combineByKey

reduceByKey	CombineByKey
reduceByKey internally calls combineByKey	CombineByKey is the generic api and is used by reduceByKey and aggregateByKey
the input type and outputType of reduceByKey are the same	CombineByKey is more flexible, hence one can mention the required outputType .

```
rdd.reduceByKey(func)
```

Is actually this

```
rdd.combineByKey(lambda x: x, func, func)
```

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combineByKey

- Takes three functions
  - createCombiner, which turns a V into a C (e.g., creates a one-element list)
  - mergeValue, to merge a V into a C (e.g., adds it to the end of a list)
  - mergeCombiners, to combine two C's into a single one (e.g., merges the lists)

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Window Function vs Group by in Spark SQL

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Group BY

- Takes three functions
  - createCombiner, which turns a V into a C (e.g., creates a one-element list)
  - mergeValue, to merge a V into a C (e.g., adds it to the end of a list)
  - mergeCombiners, to combine two C's into a single one (e.g., merges the lists)

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Window Function

Window functions operate on a set of rows and return a single value for each row from the underlying query. The term **window** describes the set of rows on which the **function** operates.

It is a popular concept in SQL world which which was introduced in Spark SQL in 1.4 versión onwards

https://databricks.com/blog/2015/07/15/introducing-window-functions-in-spark-sql.html

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Window Functions

Spark SQL supports three kinds of window functions:

- ranking functions
- analytic functions
- aggregate functions

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Window Function

	SQL	DataFrame API
Ranking functions	rank	rank
	dense_rank	denseRank
	percent_rank	percentRank
	ntile	ntile
	row_number	rowNumber
Analytic functions	cume_dist	cumeDist
	first_value	firstValue
	last_value	lastValue
	lag	lag
	lead	lead

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Spark Submit

https://spark.apache.org/docs/latest/configuration.html

There are many Spark configuration parameters please check them out

Spark provides three locations to configure the system:

- Spark properties control most application parameters and can be set by using a SparkConf object, or through Java system properties.
- Environment variables can be used to set per-machine settings, such as the IP address, through the conf/spark-env.sh script on each node.
- Logging can be configured through log4j.properties.

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Multiple Notebook Options for Spark

- Data Bricks Notebook
- Zeppelin Notebooks
- Spark Magic

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Spark Streaming

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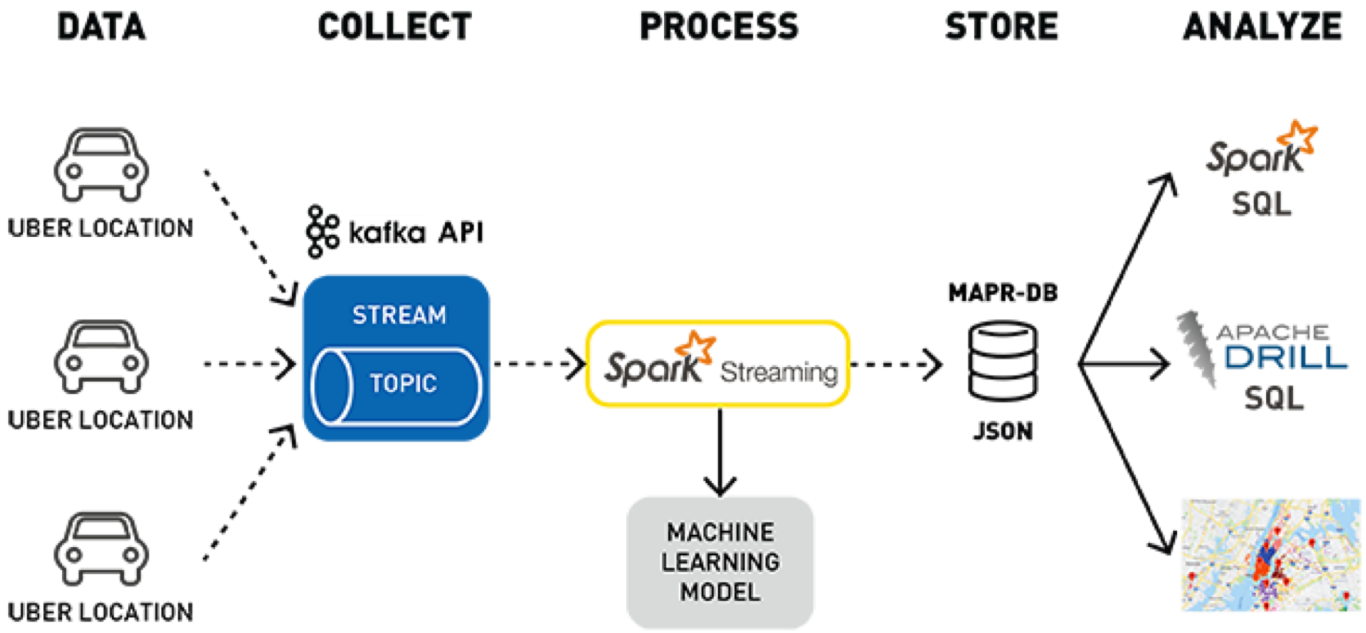
Popular Uber use case



The application of machine learning to geolocation data is being used in telecom, travel, marketing, and manufacturing to identify patterns and trends for services such as recommendations, anomaly detection, and fraud.

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Stream Processing Programing Models

Continuous – Real Time

Micro Batch – Near Real Time

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Spark Streaming

Example NetworkWordCount.

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Streaming Setup

A StreamingContext object can be created from a SparkContext object.

After a context is defined, you have to do the following.

1. Define the input sources by creating input DStreams.
2. Define the streaming computations by applying transformation and output operations to DStreams.
3. Start receiving data and processing it using streamingContext.start().
4. Wait for the processing to be stopped (manually or due to any error) using streamingContext.awaitTermination().
5. The processing can be manually stopped using streamingContext.stop().

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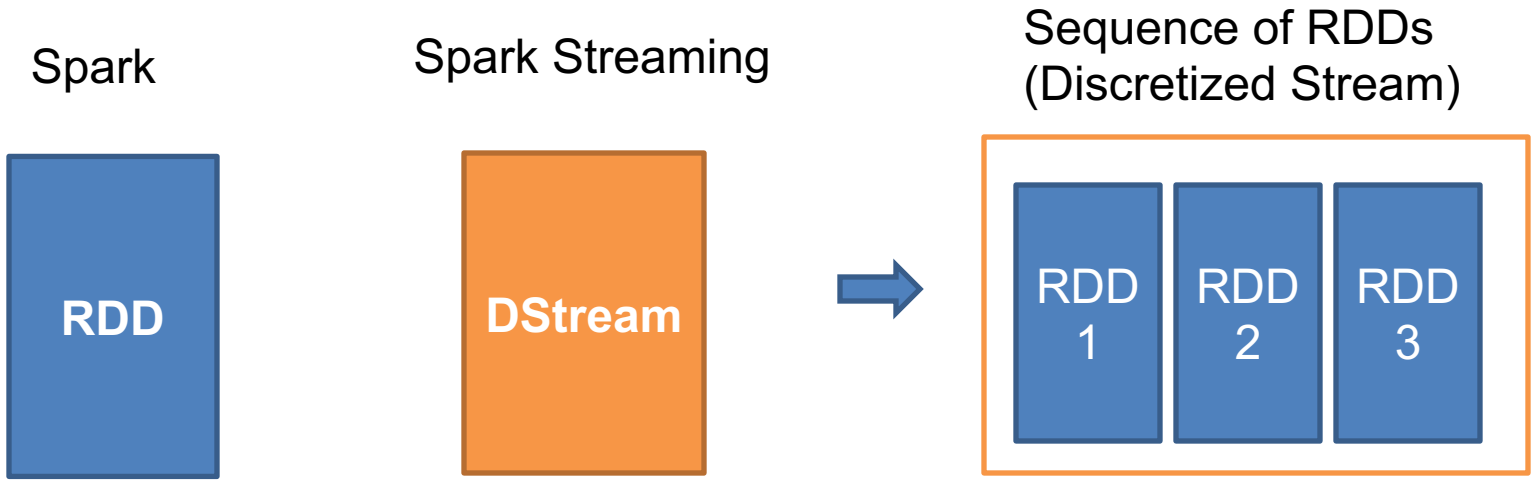
Building Block



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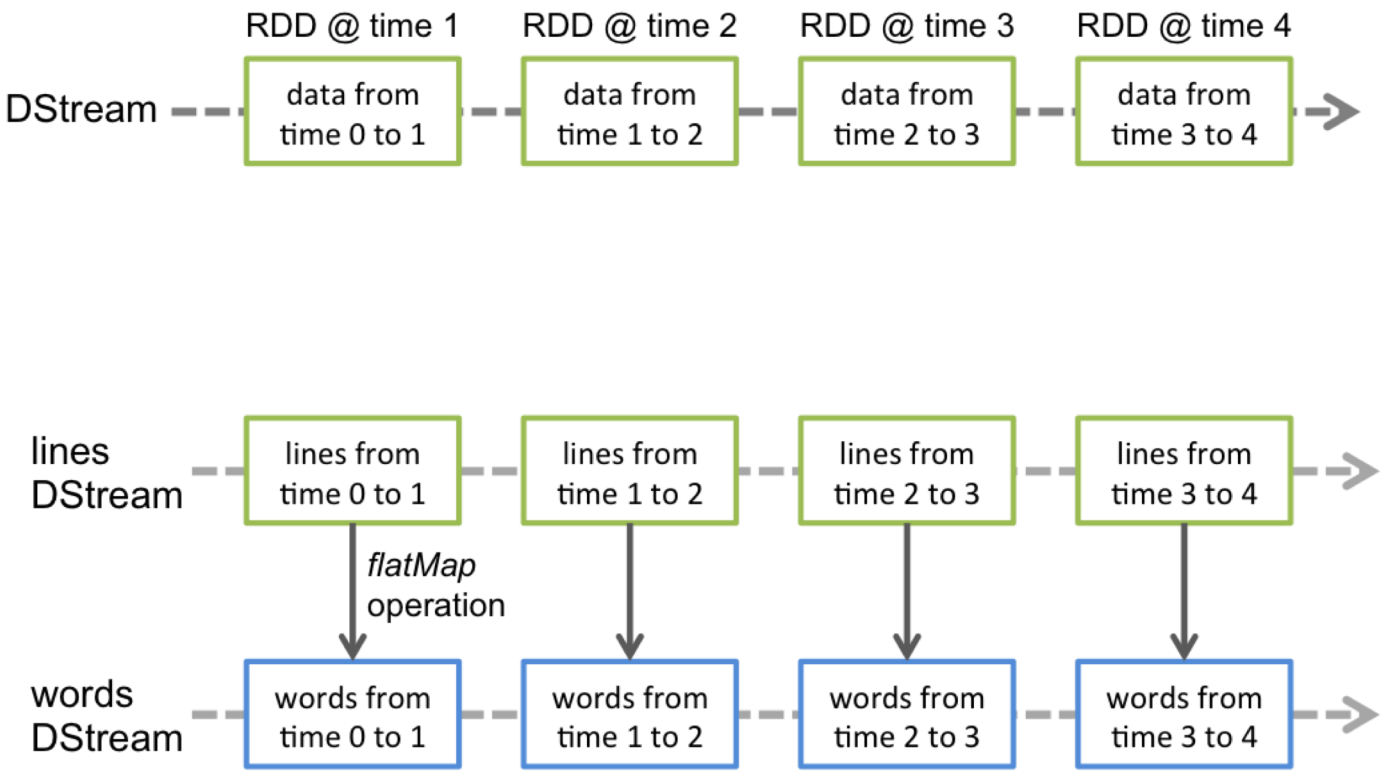
DStream



Input DStreams and Receivers

Spark Streaming provides two categories of built-in streaming sources.

- *Basic sources*: Sources directly available in the StreamingContext API. Examples: file systems, and socket connections.

- *Advanced sources*: Sources like Kafka, Flume, Kinesis, etc. are available through extra utility classes.

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Points to remember

- When running a Spark Streaming program locally, do not use “local” or “local[1]” as the master URL. Either of these means that only one thread will be used for running tasks locally. If you are using an input DStream based on a receiver (e.g. sockets, Kafka, Flume, etc.), then the single thread will be used to run the receiver, leaving no thread for processing the received data. Hence, when running locally, always use “local[n]” as the master URL, where n > number of receivers to run.

- Extendng the logic to running on a cluster, the number of cores allocated to the Spark Streaming application must be more than the number of receivers. Otherwise the system will receive data, but not be able to process it.

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DStream Transfromations

- All Basic transformations are supported
  - map
  - flatMap
  - filter
  - union
  - reduceByKey
  - .
  - .

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Stream Specific Transformation

The **updateStateByKey** operation allows you to maintain arbitrary state while continuously updating it with new information. To use this, you will have to do two steps.

- Define the state - The state can be an arbitrary data type.

- Define the state update function - Specify with a function how to update the state using the previous state and the new values from an input stream.

Example: stateful_network_wordcount.py

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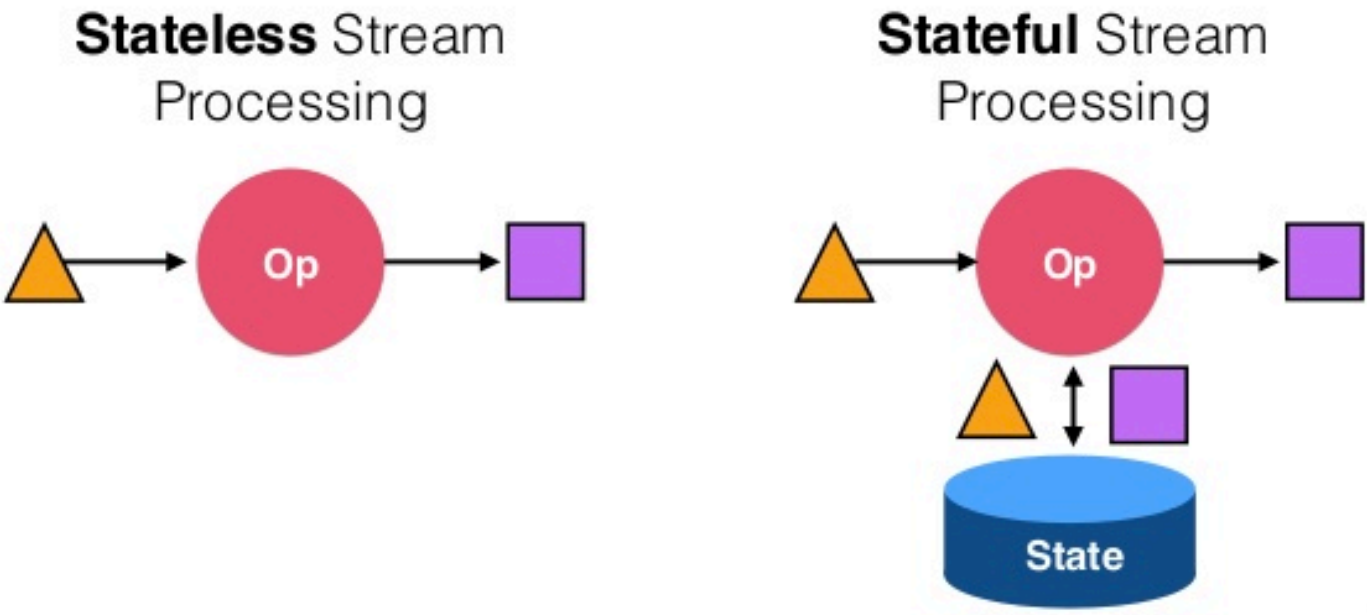
Stateful vs Stateless



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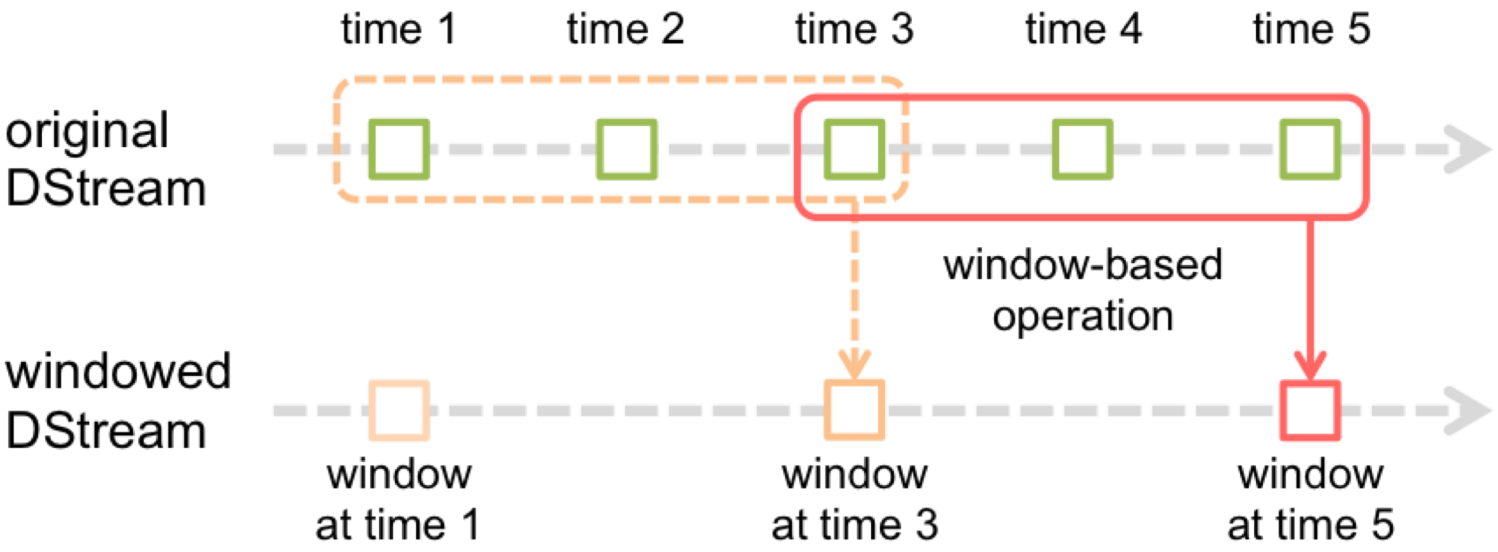
Window Operations

Again a popular term in Stream Computation



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Window definition

Window operation needs to specify two parameters.

- *window length* - The duration of the window (3 in the previous figure).
- *sliding interval* - The interval at which the window operation is performed (2 in the previous figure).

These two parameters must be multiples of the batch interval of the source DStream (1 in the previous figure).

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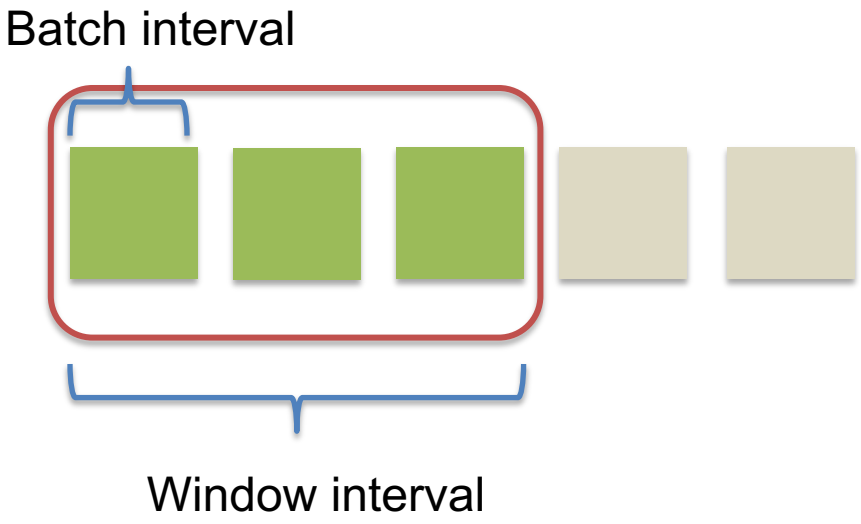
Window

1st Window



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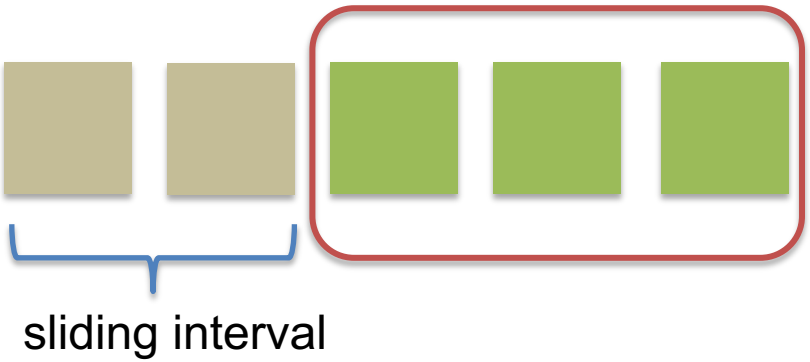
Window

2nd Window



https://spark.apache.org/docs/latest/streaming-programming-guide.html#transformations-on-dstreams

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References

- https://www.youtube.com/watch?v=g171ndOHgJ0&feature=youtu.be
- https://databricks.com/blog/2015/07/15/introducing-window-functions-in-spark-sql.html
- https://spark.apache.org/docs/latest/streaming-programming-guide.html
- https://www.youtube.com/watch?v=UuRhEmqghRM