Big Data Processing

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Agenda

- What is Spark Streaming
- Operation on DStreams

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What is Spark Streaming

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Spark Streaming

- Scalable, fault-tolerant stream processing system
- Receive data streams from input sources, process them in a cluster, push out to databases/dashboards

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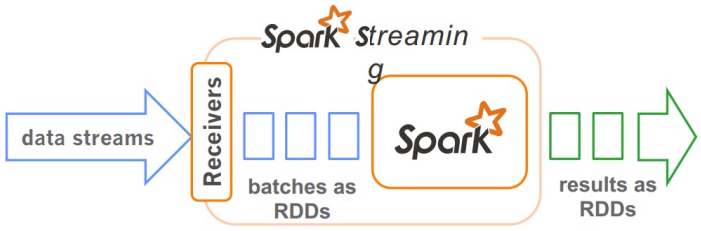
How does it work?

- The stream is treated as a series of very small, deterministic batches of data
- Spark treats each batch of data as RDDs and processes them using RDD operations
- Processed results are pushed out in batches



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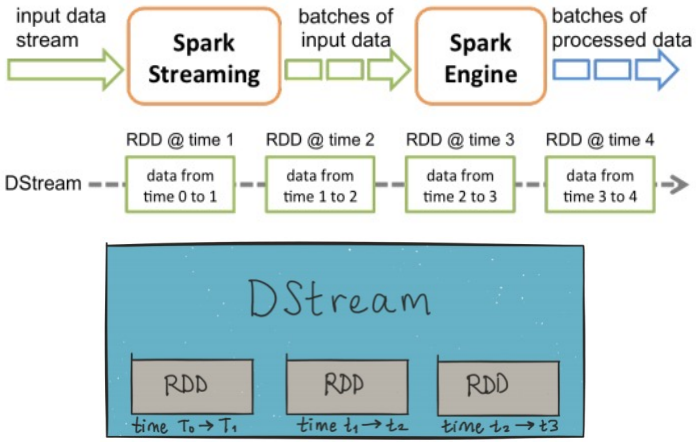
Discretized Stream (DStream)

- Sequence of RDDs representing a stream of data



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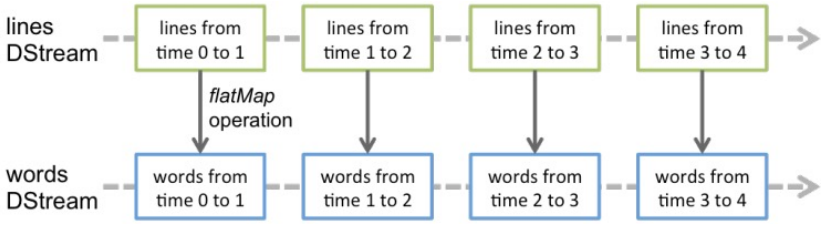
Discretized Stream (DStream)

- Any operation applied on a DStream translates to operations on the underlying RDDs



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StreamingContext

- The main entry point of all Spark Streaming functionality

```
val conf = new
SparkConf().setAppName(appName).setMaster(master)
val ssc = new StreamingContext(conf, batchinterval)
```

- appname: name of the application
- master: a Spark, Mesos, or YARN cluster URL
- batchinternval: time interval (in second) of each batch

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Operation on DStreams

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Operation on DStreams

- Three categories
  - Input operation
  - Transformation operation
  - Output operation

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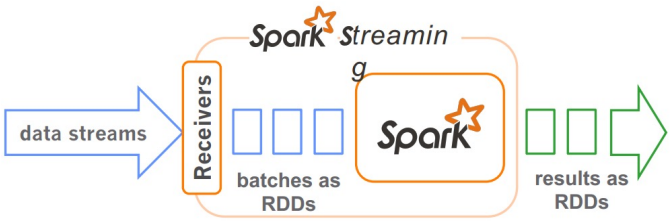
Input Operations

- Every input DStream is associated with a Receiver object
- Two built-in categories of streaming sources:
  - Basic sources, e.g., file systems, socket connection
  - Advanced sources, e.g., Twitter, Kafka



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Input Operations

- Basic sources
  - Socket connection

```
// Create a DStream that will connect to hostname:port
ssc.socketTextStream("localhost", 9999)
```

  - File stream

```
streamingContext.fileStream[…](dataDirectory)
```

- Advanced sources

```
val ssc = new StreamingContext(sparkContext, Seconds(1))
val tweets = TwitterUtils.createStream(ssc, auth)
```

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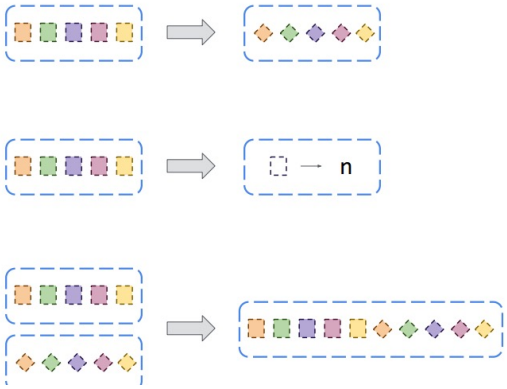
Transformation

map,
flatmap,
filter

count,
reduce,
countByValue,
reduceByKey

union,
join
cogroup



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Transformation

Transformation	Meaning
map (func)	Return a new DStream by passing each element of the source DStream through a function func
flatmap(func)	Similar to map, but each input item can be mapped to 0 or more output items
filter(func)	Return a new DStream by selecting only the records of the source DStream on which func returns true

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Transformation

Transformation	Meaning
count	Return a new DStream of single-element RDDs by counting the number of elements in each RDD of the source DStream
countbyValue	Returns a new DStream of (K, Long) pairs where the value of each key is its frequency in each RDD of the source DStream.
reduce(func)	Return a new DStream of single-element RDDs by aggregating the elements in each RDD of the source DStream using a function func (which takes two arguments and returns one).
reducebyKey(func)	When called on a DStream of (K, V) pairs, return a new DStream of (K, V) pairs where the values for each key are aggregated using the given reduce function

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Transformation

Transformation	Meaning
union(otherStream)	Return a new DStream that contains the union of the elements in the source DStream and otherDStream.
join(otherStream)	When called on two DStreams of (K, V) and (K, W) pairs, return a new DStream of (K, (V, W)) pairs with all pairs of elements for each key.

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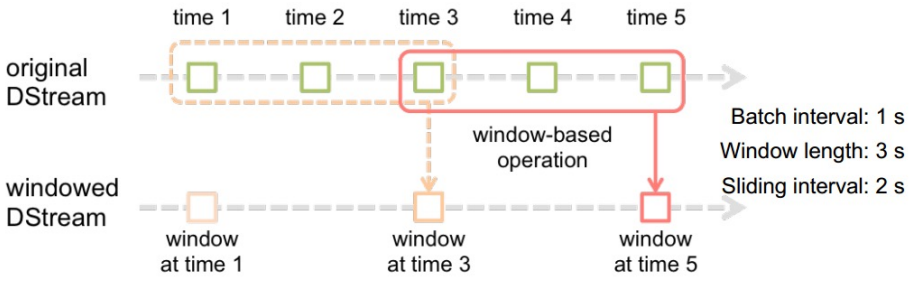
Window Operations

- Spark provides a set of transformations that apply to a sliding window of data
- A window is defined by: window length and siding interval



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Window Operations

- *window(windowLength, slideInterval)*
  - Returns a new DStream which is computed based on windowed batches
- *countByWindow(windowLength, slideInterval)*
  - Returns a sliding window count of elements in the stream.
- *reduceByWindow(func, windowLength, slideInterval)*
  - Returns a new single-element DStream, created by aggregating elements in the stream over a sliding interval using func.

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Output Operation

- Push out DStream's data to external systems, e.g., a database or a file system

Operation	Meaning
print	Prints the first ten elements of every batch of data in a DStream on the driver node running the application
saveAsTextFiles	Save this DStream's contents as text files
saveAsHadoopFiles	Save this DStream's contents as Hadoop files.
foreachRDD(func)	Applies a function, func, to each RDD generated from the stream

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Example

Word Count

```
val context = new StreamingContext(conf, Seconds(1))
val lines = context.socketTextStream(...)
val words = lines.flatMap(_.split(" "))
val wordCounts = words.map(x => (x, 1)).reduceByKey(_+_)
wordCounts.print()
context.start()
```

Print the DStream contents on screen

Start the streaming job

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Lifecycle of a streaming app

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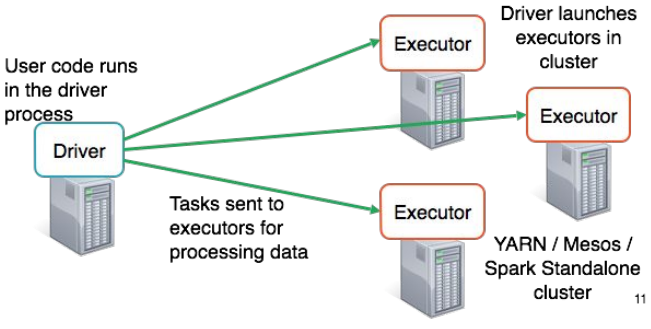
Execution in any Spark Application



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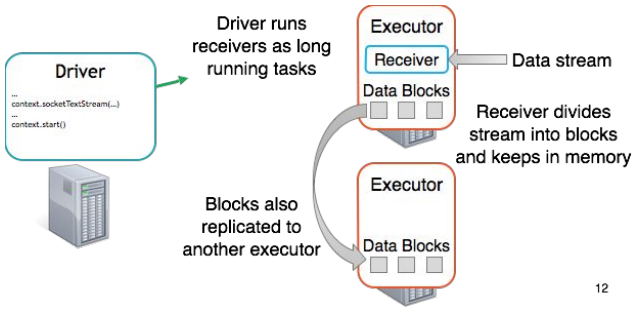
Execution in Spark Streaming: Receiving data



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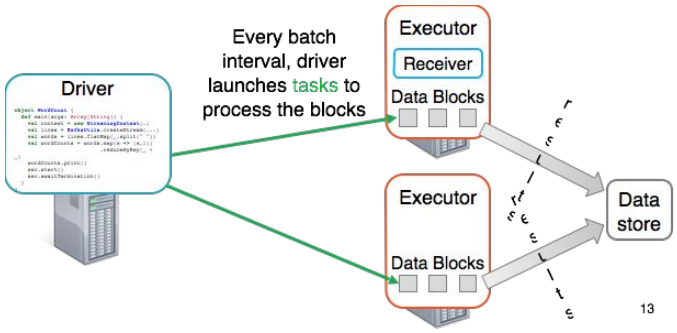
Execution in Spark Streaming: Processing data



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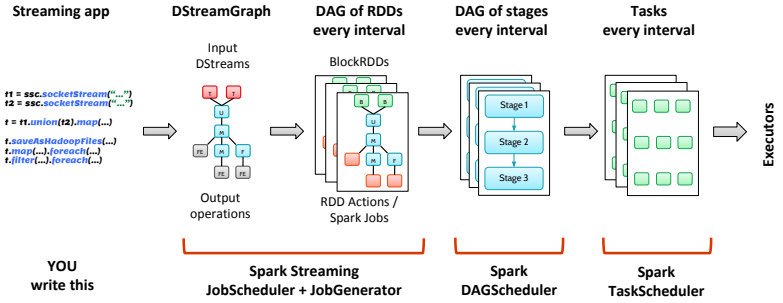
End-to-end view



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Dynamic Load Balancing

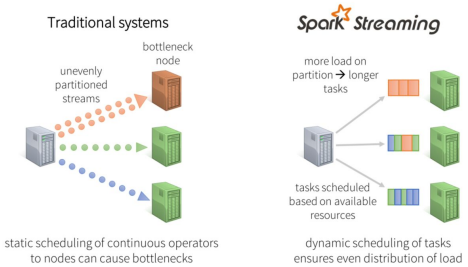

Figure 3: Dynamic load balancing

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Fast failure and Straggler recovery

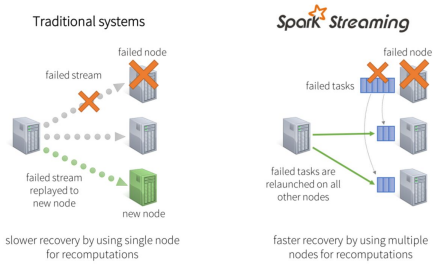

Figure 4: Faster failure recovery with redistribution of computation

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Acknowledgement and References

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- Holden Karau, Andy Konwinski, Patrick Wendell & Matei Zaharia. Learning Spark. Oreilly
- James A. Scott. Getting started with Apache Spark. MapR Technologies

Slides:

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- Matteo Nardelli. Spark Streaming: Hands on Session
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