REACTIVE STREAMS, linking REACTIVE APPLICATIONS to SPARK STREAMING

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SPARK SUMMIT EAST
DATA SCIENCE AND ENGINEERING AT SCALE
FEBRUARY 16-18, 2016 NEW YORK CITY

Agenda

- Back pressure
- Back pressure in Spark Streaming
- Reactive Application
- Reactive Streams
- Demo

Back Pressure

Back Pressure

- a slow consumer should slow down the producer
  - the produce applies pressure
  - the consumer applies back pressure
- the classic example: TCP

Spark Streaming

Spark Streaming

Spark Streaming

Congestion support in Spark 1.4

Static rate limit

- `spark.streaming.receiver.maxRate`
- conservative
- difficult to find the right limit (depends on cluster size)
- one limit to all streams

Spark Streaming

Back pressure in Spark 1.5

Dynamic rate limit

- rate estimator
  - estimates the number of element that can be safely processed by system during the batch interval
- rate sent to receivers
- rate limiter
  - relies on TCP to slow down producers

Spark Streaming

Rate estimator

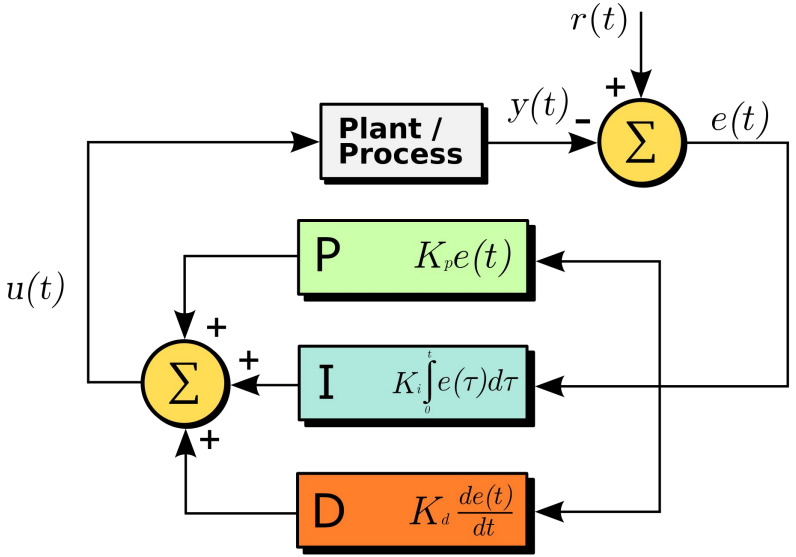
- each BatchCompleted event contains
  - processing delay, scheduling delay
  - number of element in mini-batch
- the rate is (roughly) elements / processingDelay
- but what about accumulated delay?

Spark Streaming

Rate estimator

Proportional-Integral-Derivative

- P, I, D constants change convergence, overshooting and oscillations



https://en.wikipedia.org/wiki/PID_controller

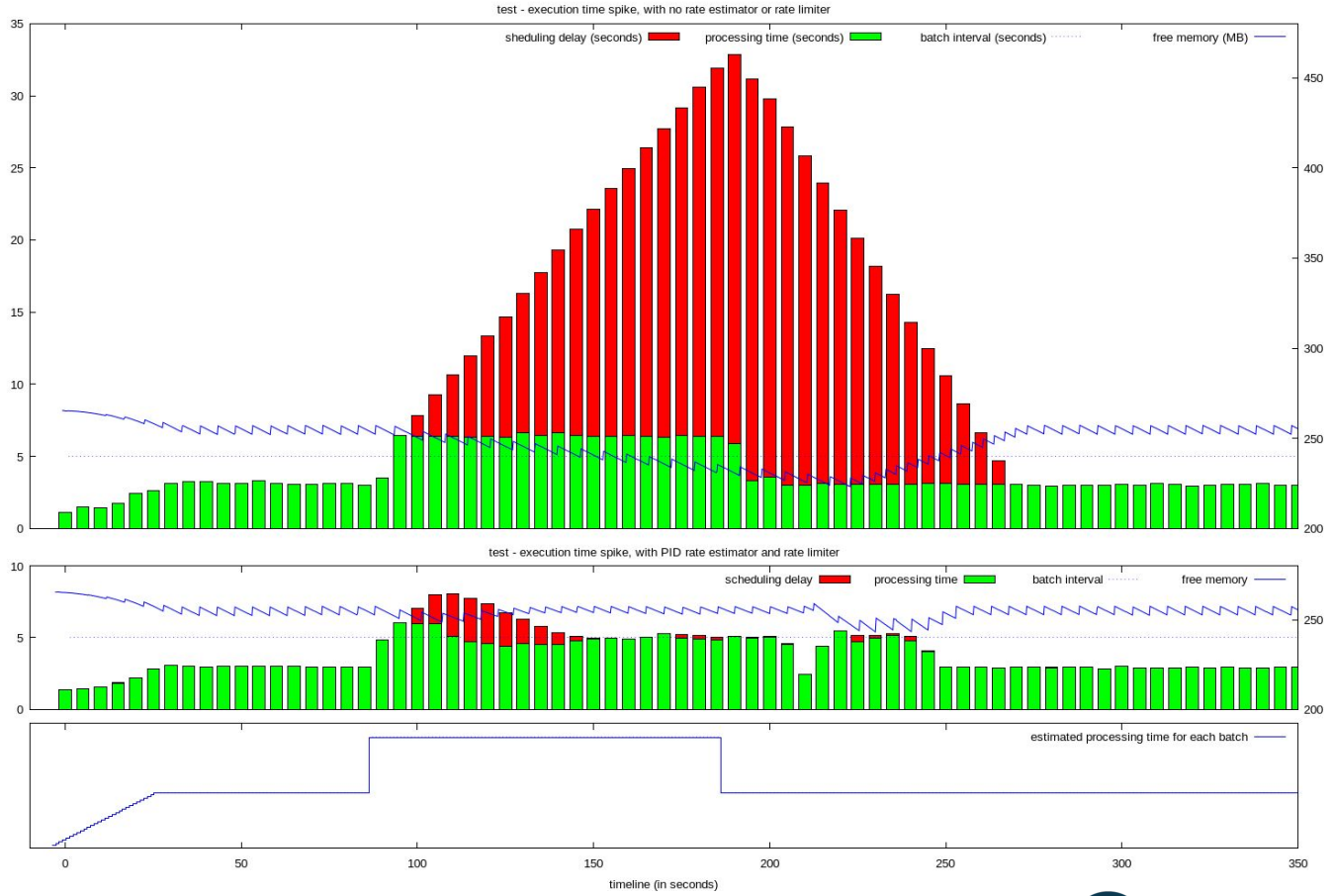
Spark Streaming

Back pressure in Spark 1.5

- each input has its own estimator
- work with all stream receivers

  including KafkaDirectInputStream

- configuration
  - `spark.streaming.backpressure.enable  true`
  - `spark.streaming.backpressure.minRate  R`


test - execution time spike, with no rate estimator or rate limiter
sheduling delay (seconds)
processing time (seconds)
batch interval (seconds)
free memory (MB)
test - execution time spike, with PID rate estimator and rate limiter
scheduling delay
processing time
batch interval
free memory
estimated processing time for each batch
timeline (in seconds)

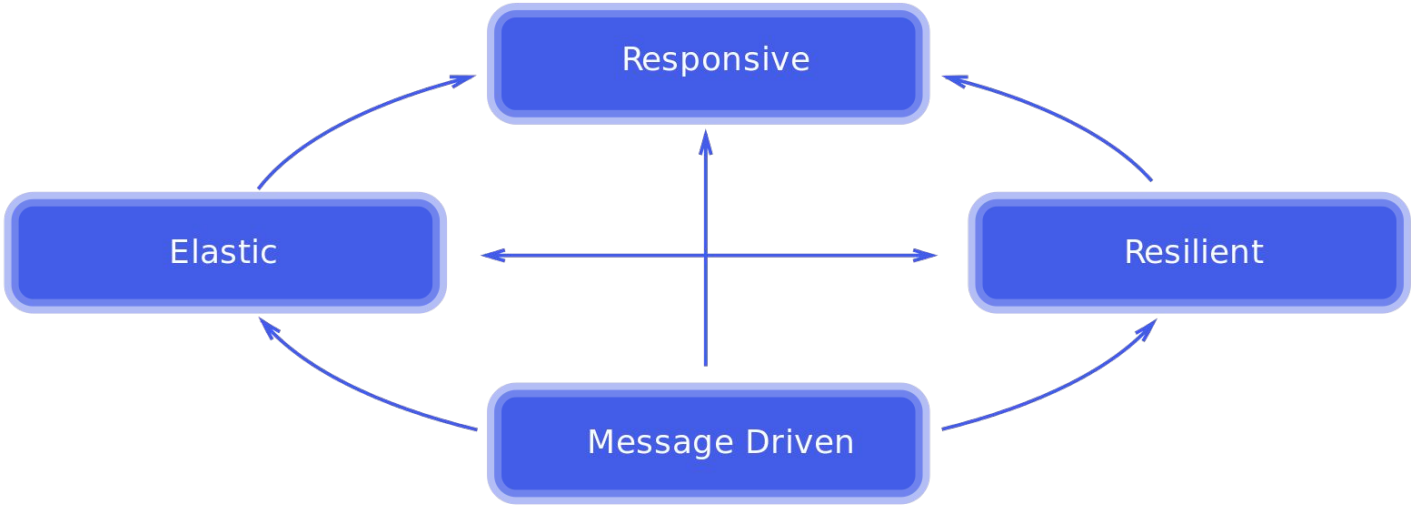
Spark Streaming

Limitations

- linearity assumption
- records with similar execution times
- TCP back pressure accumulates in the TCP channel

Reactive Application

Reactive Application



http://www.reactivemanifesto.org

Reactive Application

Responsive	responds in a timely manner
Resilient	stays responsive in the face of failure
Elastic	stays responsive under varying workload
Message Driven	relies on asynchronous message-passing

Reactive Streams

Reactive Streams

- one tool to create reactive applications
- specification for back pressure interface to connect systems supporting back pressure in the JVM
  - small: 3 interfaces, 7 methods total
- subscriber controls rate by requesting elements from producers

http://www.reactive-streams.org

End to end back pressure

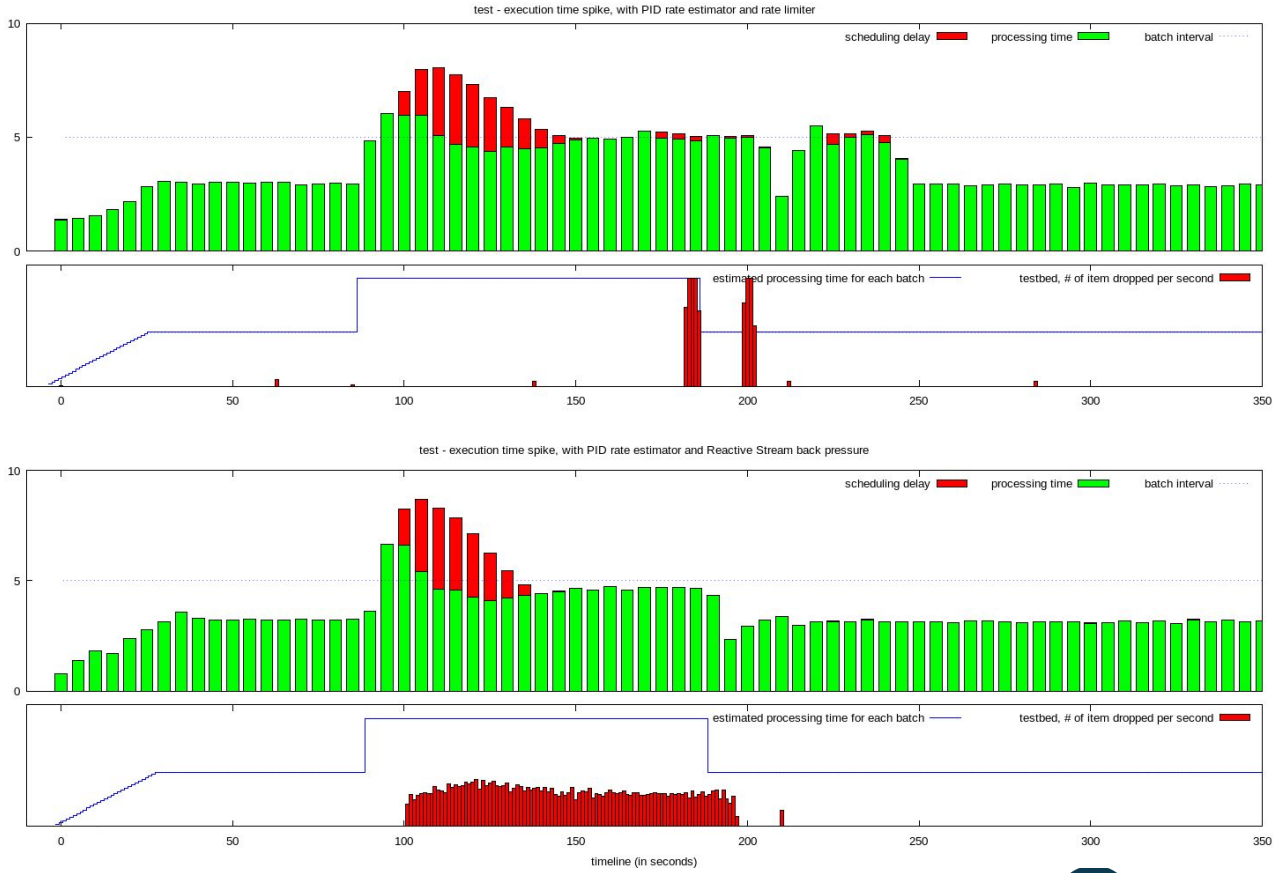
End to end back pressure

- Reactive application with reactive streams connector

  ⇒ back pressure enabled
- Spark Streaming 1.5+

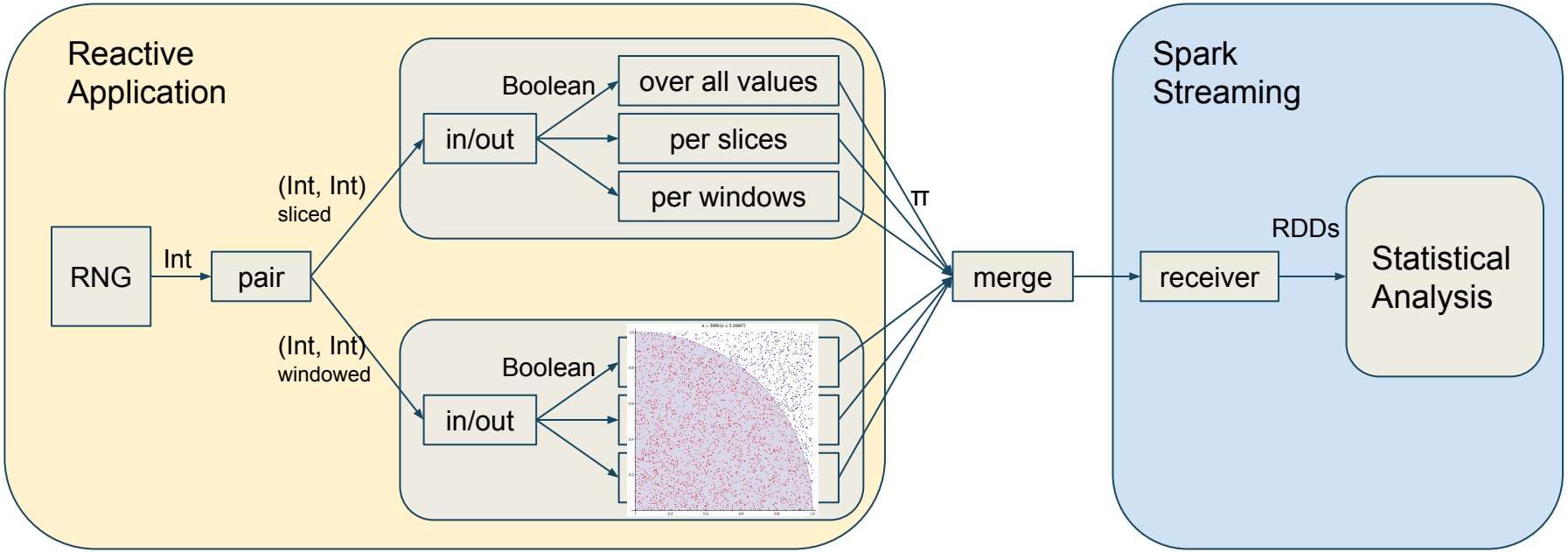
  ⇒ back pressure enabled
- Reactive streams Spark Streaming receiver

  ⇒ end to end back pressure


test - execution time spike, with PID rate estimator and rate limiter
scheduling delay
processing time
batch interval
estimated processing time for each batch
testbed, # of item dropped per second
test - execution time spike, with PID rate estimator and Reactive Stream back pressure
timeline (in seconds)

Demo

Demo



What's Next?

- Last bit of API change (in Spark 2.0)

  SPARK-10420

- Publish the Reactive Streams Receiver

THANK YOU.

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