@DEANWAMPLER

CHICAGO SPARK, MAY 18, 2016

SPARK 2.0

MEETUPS

- We need speakers and topics for future meetings!
- Thanks to Expedia for hosting…
- … and congratulations on your 20 year anniversary!

GOTO CHICAGO IS NEXT WEEK!!

- http://gotocon.com/

SPARK SUMMIT SF, JUNE 6–8

- spark-summit.org/2016/
- Discount codes:
  - Meetup16SF N% (?)
  - reynold16 20%

ABOUT YOU…

- Who's looking?
- Who's hiring?
- What topics should we cover soon?

SPARK 2.0.0

A NEW HOPE?

LIBERALLY BORROWED FROM…

- http://go.databricks.com/apache-spark-2.0-presented-by-databricks-co-founder-reynold-xin
- You should really view this webinar…

Graphs with the Databricks icon in the lower-left corner were taken from this presentation.

WHAT DOES A 2.0.0 RELEASE MEAN?

- Some new and restructured APIs.
- Some breaking API changes?
  - They try *very hard* to avoid changing user-visible APIs.
    - Some dependency changes, e.g., Guava.
    - Changes in experimental APIs (e.g., Datasets).

THREE MAJOR CHANGES

- Tungsten Phase 2
  - 5x-20x additional performance improvements.
- SQL 2003 and Unified DataFrames/Datasets API.
- Structured Streaming
  - Integration of DataFrames/Datasets and Streaming.

TUNGSTEN

PHASE 2

FOR AN ADDITIONAL 10X IMPROVEMENT…

- Removing hot spots only gains a few %.
- Ask instead, if we start from scratch, what's the fastest it could be?

```
select count(*) from sales
where sku = 1234;

int count = 0;
for (Record sale: sales) {
  if (sale.sku == 1234)
    count += 1;
}
```

FOR AN ADDITIONAL 10X IMPROVEMENT…

- Instead, databases (and Spark) use the “volcano pattern”, where each filter is actually an iterators.
  - Infrastructure adds overhead, easily 10x.

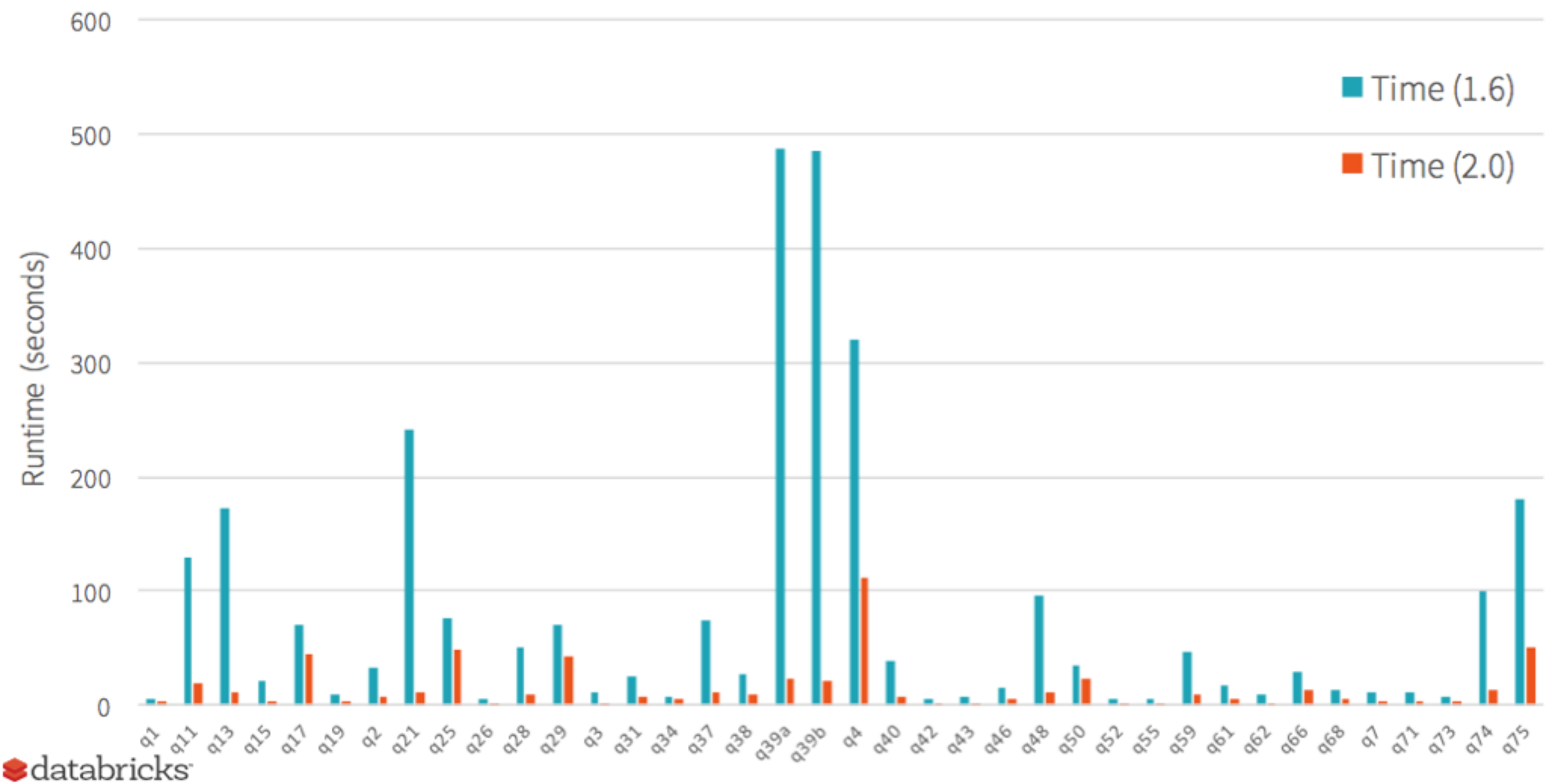
FOR AN ADDITIONAL 10X IMPROVEMENT…

- After compiling the query, generate custom code!
  - No virtual function calls.
  - Put data in CPU registers, when possible.
  - Unroll loops.
  - Exploit parallelism and pipelining.

RESULTS

Operation	Spark 1.6	Spark 2.0
filter	15ns	1.1ns
sum with/without group by	79/14ns	10.7/0.9ns
hash join	115ns	4.0ns
sort (8/16 bit entropy)	620/620ns	5.3/8.0ns
sort-merge join	750ns	700ns

PRELIM. TPC-DS BENCHMARK (LOWER IS BETTER)



databricks

EXAMPLE

- http://bit.ly/1X8LKmH
- (Example from Databricks Cloud)

DATASET, DATAFRAME

SQL

SQL 2003 COMPLIANCE

- Spark SQL now supports all 99 TPC-DS benchmark queries.
- New SQL parser (with better error messages).
- Also
  - Subqueries, correlated and uncorrelated.
  - Approximate aggregate statistics.

DATASETS VS. DATAFRAMES

- 2015: Datasets bring *field* type safety back to DataFrames.
  - Like static type safety provided by the RDD API:
    - `Dataset[T]` analogous to `RDD[T]`, where `T` is the record type.
  - In DataFrames, fields (columns) untyped => `Row` type.
- Now: `DataFrame = Dataset[Row]`

SPARKSESSION

- `SparkSession`: The new "`SparkContext`" for `DataFrame/Dataset`.
- Entry point for ingesting data (like `SQLContext` was).
- Metadata, configuration, and cluster resource management.

FUTURE?

- `RDD`: Will remain the low-level API.
- But `Dataset/DataFrame` will be the focus of optimizations, rich semantics.
- Higher-level libraries will be migrated to `Dataset/DataFrame`:
  - Structured streaming
  - ML pipeline replacing MLlib
  - GraphFrames

OTHER, MISCELLANEOUS API IMPROVEMENTS

- ML pipeline coverage in all languages (Java, Python, R, as well as Scala) nearly complete.
- Improved R support:
  - Parallelizable user-defined functions in R.
  - More Models!
    - Generalized Linear Models (GLMs), Naïve Bayes, Survival Regression, K-Means.

EXAMPLES

- http://bit.ly/1SMPEzQ
- http://bit.ly/1OeqdSn
- (Examples from Databricks Cloud)

STRUCTURED

STREAMING

WHY STREAMING?

- Spark started as a batch mode system, but…
  - … the mini batch model lets Spark capture data in small time windows and run batch jobs over it.
- This also lets you use business logic in both batch and streaming contexts, which is great.
- If you are not latency sensitive, mini batch lets you do fancy things:
  - “Online” training of ML models, track moving state, run SQL queries, …

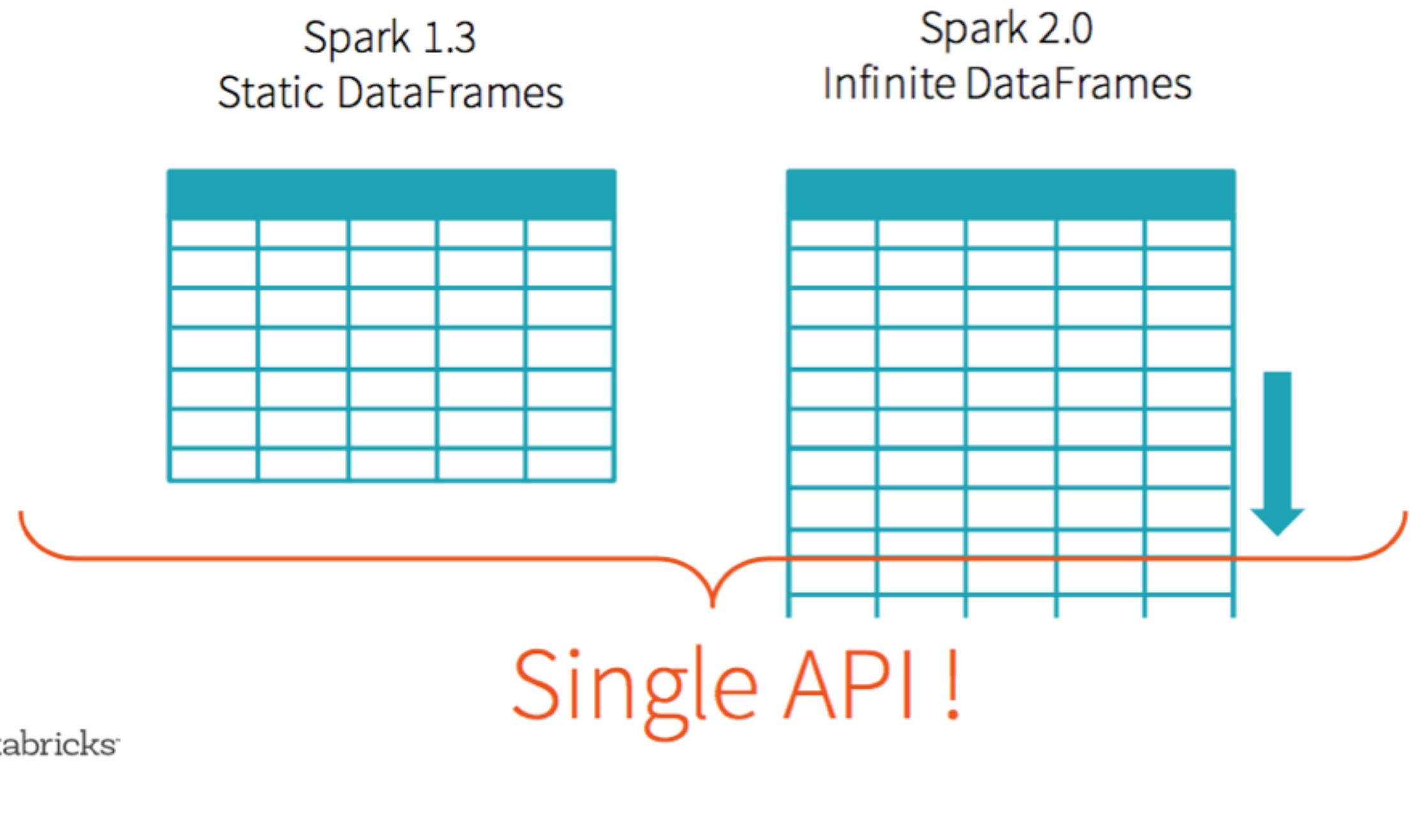
STREAMING IS HARD

- I'm counting sales/hour, but some messages get delayed for several hours. Now what?
- Event time vs. processing time.
- What does group by or join mean in a streaming context?
- If I'm maintaining stream state and it crashes, how do I recover?

STREAMING IS HARD

- Semantics are nontrivial:
  - https://www.oreilly.com/ideas/the-world-beyond-batch-streaming-101
  - https://www.oreilly.com/ideas/the-world-beyond-batch-streaming-102
  - Excellent Kafka Summit talk by Frances Perry and Tyler Akidau
  - … and others.

GOAL: ELIMINATE THE NEED TO REASON ABOUT STREAMING



CLASSIC BATCH JOB

```
val logs = ctx.read.format(“json”).
  open(“s3://mybucket/logs”)

logs.groupBy(logs.user_id).
  agg(sum(logs.time)).
  write.format(“jdbc”).
  save(“jdbc:mysql//…”)
```

. . . CONVERTED TO A CONTINUOUS AGGREGATION

```
val logs = ctx.read.format(“json”).
  stream(“s3://mybucket/logs”)

logs.groupBy(logs.user_id).
  agg(sum(logs.time)).
  write.format(“jdbc”).
  startStream(“jdbc:mysql//…”)
```

- open changed to stream.
- save changed to startStream.

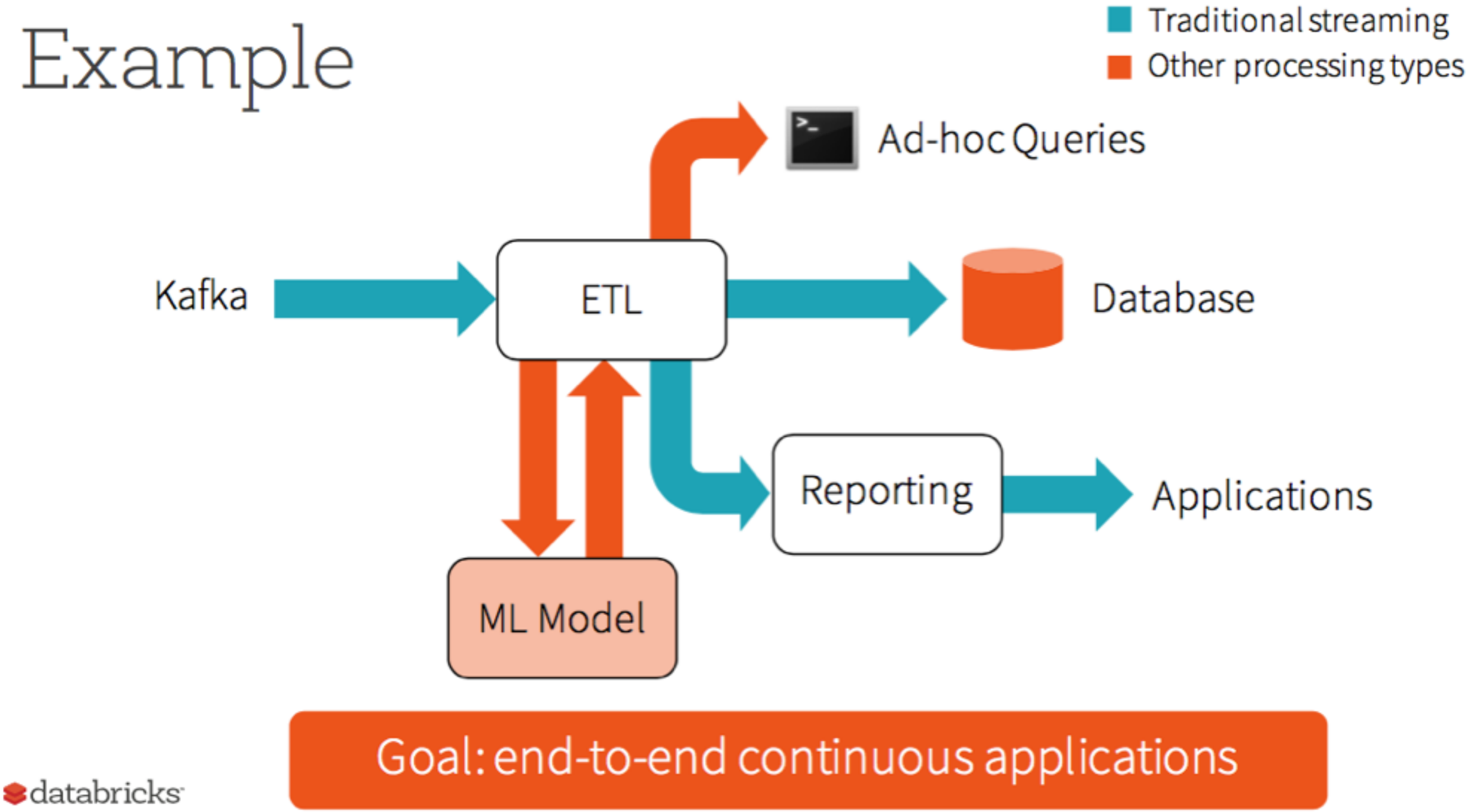
SO, STRUCTURED STREAMING IS…

- High-level streaming API built on SparkSQL engine, rather than RDDs.
- Supports:
  - Event time vs. processing time.
  - Windowing.
  - Sessions.
  - Misc. sources and sinks.

SO, STRUCTURED STREAMING IS…

- Queries:
  - The usual SQL-like aggregations, etc.
  - Query the steam state using JDBC.
  - Change queries at runtime.
  - Build and apply machine learning models.
- Build “continuous applications”.

Example



Goal: end-to-end continuous applications

FUTURE?

- There is talk of rewriting Spark Streaming to be a “true” streaming engine.
  - Low latency.
  - Full support for common streaming semantics
    - (i.e., as discussed in the Tyler Akidau blogs.)
- Needs to stay competitive with Apache Beam, Flink, and Gearpump.

FOR MORE

INFORMATION

RESOURCES

- Structured Streaming Strata Talk
  - https://www.oreilly.com/learning/apache-spark-2-0--introduction-to-structured-streaming
- 2.0 Preview:
  - code: http://home.apache.org/~pwendell/spark-releases/spark-2.0.0-preview-bin/
  - docs: http://home.apache.org/~pwendell/spark-releases/spark-2.0.0-preview-docs/
  - Databricks Cloud Preview.

RESOURCES

- lightbend.com/fast-data
- dean.wampler@lightbend.com
- @deanwampler
- polyglotprogrammin.com/talks

- Questions?