From Big Data towards Fast Data

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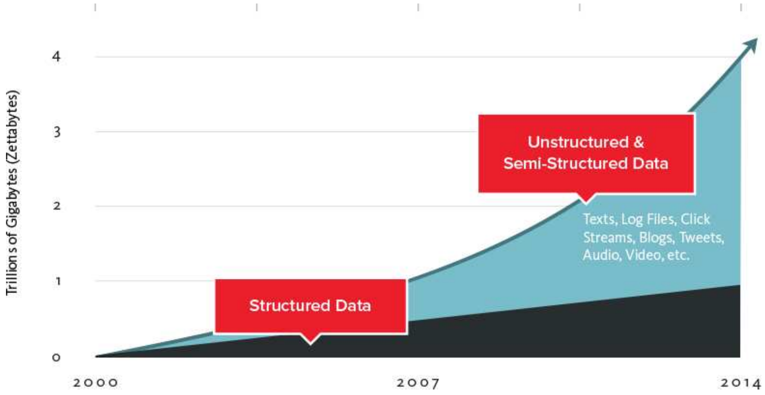
Data today



Source: `http://www.couchbase.com/nosql-resources/what-is-no-sql`

How big are Big data?

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Source: `https://twitter.com/DEVOPS_BORAT/status/288698056470315008`

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- You can scale up, but sooner or later you'll probably have to scale out
- Need for highly scalable solution also because of cost effectiveness

Big data - challenges and approaches

- Analysis run on top of the huge amount of data
- Ability to store huge amount of unstructured data (often for performance reasons)
- But also ability to talk to RDBMS or query structured data is often needed as well
- Scalable solution
- Cloud architecture - everything is ephemeral

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How these challenges are usually addressed:

- Data replication
- Map-reduce model

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Probably the most popular implementation:

- hadoop

Speeding up! I.

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Keep computation intensive data in memory

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Keep computation intensive data in memory

Don’t replicate every single change of the data

Apache Spark

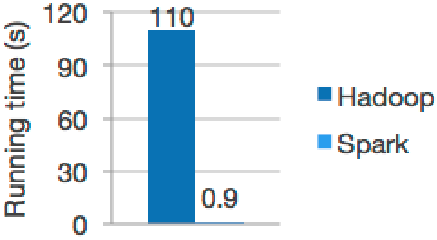
Resilient Distributed Dataset (RDD)

- Immutable distributed collection of data
- RDD is split into multiple partitions - can be located on different nodes
- Generated by a set of deterministic operations applied on a data source or other RDDs
- Provides 2 types of operations:
  - **transformation** creates new RDD (e.g. `map()` or `filter()`) - return type is always RDD
  - **action** computes a result from RDD (e.g. `count()` or `first()`)
- Lazy evaluation - only upon calling action on RDD
- RDD contains enough information (its linage) to be (re)created from a stable source

See M. Zaharia et al., NSDI, 2012.

Apache Spark

- For some type of jobs (e.g. iterative algorithms) substantial speed up
- Speed up of one, sometimes even two orders of magnitude



Logistic regression (an ML algorithm for classification) in Hadoop and Spark
Source: `http://spark.apache.org/`

Speeding up! II.

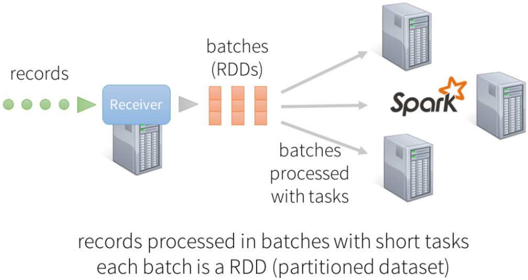
Speeding up! II.

Process data immediately once it arrives

Spark streaming

- Discretized Streams (DStreams) - RDD micro-batches
- User defined (time) size of the batch

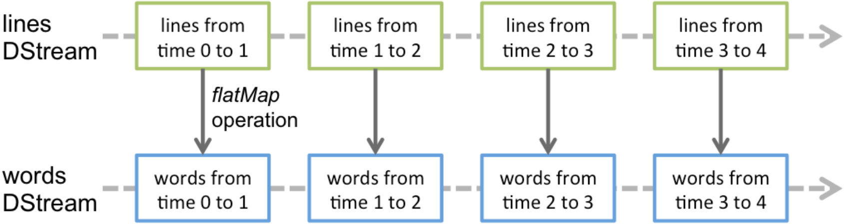
```
val conf = new SparkConf().setAppName("WordCount")
val ssc = new StreamingContext(conf, Seconds(1))
```



Source: `https://databricks.com/blog/2015/07/30/diving-into-spark-streamings-execution-model.html`

Spark streaming

```scala
// Split each line into words
val words = lines.flatMap(_.split(" "))
```



Source: `http://spark.apache.org/docs/latest/streaming-programming-guide.html`

Homework for you: Real-time stream processing frameworks

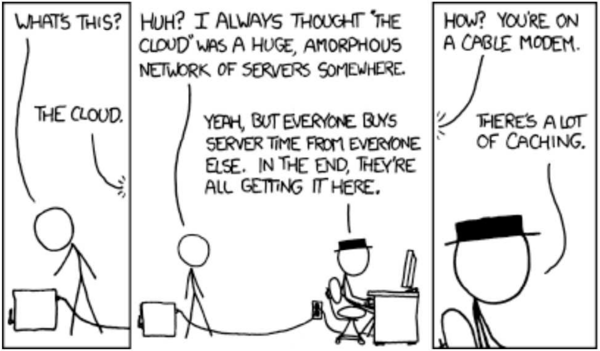
Apache Storm

Apache Flink

Apache Samza

Speeding up! III.

Keep the data in memory all the time



Source: Part of xkcd #908

In-memory data grid: Infinispan

http://infinispan.org/

- Data grid platform, written in Java
- In-memory No-SQL key-value data store, (optionally) schema-less
- Distributed cache - offers massive memory
- Elastic and scalable - can run on hundreds of nodes
- Highly available - no SPOF, resilient to node failures
- Transactional
- Supports indexing and searching
- Many other features

Infinispan integration with Spark

- Connector enables read ISPN data from Spark or write Spark data to ISPN
- Spark partitions contain only cache segments owned by the associated ISPN server

Creating RDD from data in ISPN cache

```
val config = new Properties
config.put("infinispan.rdd.cacheName", "my-cache")
config.put("infinispan.client.hotrod.server_list", "
    127.0.0.1:11222")
val ispnRDD = new InfinispanRDD[String, String](sc,
    configuration = config) //for String String pairs
```

Creating DStream from data in ISPN cache

```
//same config as in previous example
val ispnStream = new InfinispanInputDStream[String, Double
    ](ssc, StorageLevel.MEMORY_ONLY, config)
```

Infinispan integration with Spark

- ISPN server side filters and converters can be used for adjusting RDDs when created
- ISPN queries can be applied to RDDs

Creating RDD/DStream by querying ISPN cache

```
val query = Search.getQueryFactory(cache).from(classOf[User
    ]).having("name").equal("Vojtech").toBuilder[RemoteQuery
    ].build
val filteredRDD = rdd.filterByQuery(query, classOf[User])
```

Writing RDD/DStream to ISPN cache

```
//same config as in previous examples
InfinispanDStream[String, Double](temperatureStream).
    writeToInfinispan(config)
```

Few other ISPN highlights wrt. fast data processing

- Event listeners

```java
@ClientListener
public static class MyListener {
    @ClientCacheEntryCreated
    @ClientCacheEntryModified
    public void onEntryChange(ClientCacheEntryModifiedEvent<String> event) {
       //TODO some action when entry is created or modified
    }

    @ClientCacheEntryRemoved
    @ClientCacheEntryExpired
    public void entryRemove(ClientCacheEntryRemovedEvent<String> event) {
      //TODO some action when entry is removed or expired
    }
}
```

- Continuous query

```java
QueryFactory qf = Search.getQueryFactory(myCache);
Query query = qf.from(User.class).select("name").having("age").lte(30).toBuilder().build();
ContinuousQueryListener<Object, Object> listener = new MyListenerI<Object, Object>();
ContinuousQuery<Object, Object> cq = new ContinuousQuery<>(cache);
cq.addContinuousQueryListener(listener, query);
```

- Distributed streams - implementation of `java.util.stream.Stream` over (distributed!) cache data

Where do we get from Big data?

- Data is kept in memory all the time and thus processing and exchanging the data is much faster
- Data is processed once it arrives
- Results of the analysis can be pushed to user by various means, e.g. using continuous queries

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== Fast data?

”Hello world” Demo

Infinispan integration with Apache Spark:

Temperature average

- Stream of temperature measurements from different places stored into Infinispan
- Average temperature is continually recomputed for each place in Spark
- Results are stored back in Infinispan

Sources available on

https://github.com/vjuranek/presentations/tree/master/DevConf_Brno2016

"Hello world" Demo

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- One Infinispan server for storing incoming data and results
- One app randomly generating place and temperature (simulating e.g. network of temperature sensors)
- Spark streaming for computing the average temperature at given place
- Client app showing result data when they arrive, using Infinispan cache listener

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Infinispan provides many useful features like integration with Apache Spark, continuous query, cache listeners and many others

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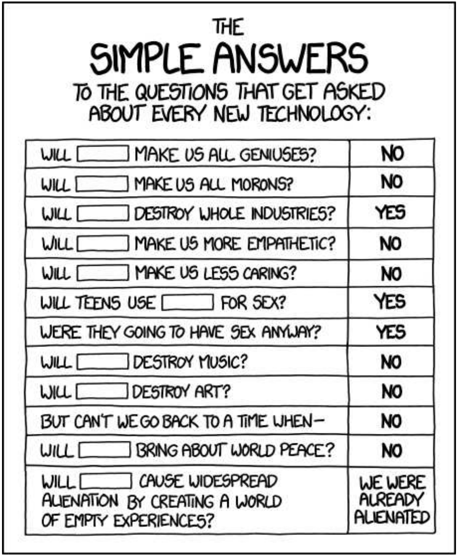
- Do the data analysis with frameworks which keep the data in memory during processing
- Process data once it arrives
- If possible, keep data in memory during whole application stack
- Infinispan provides many useful features like integration with Apache Spark, continuous query, cache listeners and many others

Question?



Source: `https://xkcd.com/1289/`

http://infinispan.org/

Thank you for your attention!