The “Big Data” Ecosystem at LinkedIn

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Based on the paper “The Big Data Ecosystem at LinkedIn”, written by Roshan Sumbaly, Jay Kreps, and Sam Shah.
The Ecosystems
Hadoop Ecosystem
Data Integration Problem
“Some analysts performed this integration themselves. In other cases, analysts—especially application users and scripters—relied on the IT team to assemble this data for them.”

–Sean Kandel et al. Enterprise Data Analysis and Visualization: An Interview Study
Ecosystem at LinkedIn
Online datacenters

Hadoop for ETL

Offline production datacenters

Offline development datacenters
Online datacenters

Offline production datacenters
ETL

*Extract-Transform-Load*

More information about *ETL* is available from Cloudera
Online Datacenters

- Voldemort
- Oracle
Voldemort

• Combines In-memory caching and storage system
• Possible to emulate the storage layer
• Reads and Writes scale horizontally
• Simple API
• Transparent data partitioning

More information about Voldemort is available at: http://www.project-voldemort.com/voldemort/
Next

- Ingress and egress out of Hadoop system
- Data flows
Ingress

From online to offline
Online datacenters

Hadoop for ETL
• **Database**
  includes information about users, companies, connections, and other primary site data.

• **Event data**
  includes logs of page views being served, search queries, and clicks.
Challenges

• Provide infrastructure that can make all data available without manual intervention or processing.
Challenges

• Datasets are so large
• Data is diverse
• Data schemas are evolving
• Data monitoring and validating
Kafka

A high-throughput distributed messaging system, for *all activity data*.
• Persist messages in a write-ahead log, partitioned and distributed over multiple brokers
• Allows data publishers to add records to a log
• New data streams to be added and scaled independent of one another.
Example

• Collecting data about searches being performed. The search service would produce these records and publish them to a topic named “SearchQueries” where any number of subscribers might read these messages.
Data Evolution

• Requires schemas changes

• Two common solutions:
  • Load data streams in whatever form they appear.
  • Manually map the source data into a stable, well-thought-out schema.
LinkedIn’s Solution

- Retains the same structure throughout our data pipeline
- Enforces compatibility and other correctness conventions
- *Schema* evolves automatically
- *Schema* check is done at compile and run time.
- Review process.
Load into Hadoop

• Pull data from Kafka to Hadoop with a *Map-only* job.

• Recurrence every 10 minutes.

• Scheduled by *Azkaban* scheduling system
• Two Kafka clusters kept synchronized automatically.
• The primary Kafka supports production.
Audit

- Each step in the flow all publish an audit trail
- Consist of the topic, machine name, etc.
- Confirm all published event reached all consumers by aggregating audit data.
Workflow

Processed offline
Workflow in Hadoop

- A directed acyclic graph of dependencies.
- Wrappers help restrict data being read to a certain time range based on parameters specified.
- Hadoop-Kafka data pull job places the data into time-partitioned folders.
Workflow in Hadoop

• A directed acyclic graph of dependencies.

• One workflow can have a size of 50-100 jobs.
Azkaban

An open-sourced workflow scheduler.
Azkaban

- Supports multiple job types
- Run as individual or chained
- Configurations and dependencies are maintained
- Visualize and manipulate dependencies via graphs in UI.
Construction of Workflows

- Experimenting, massage it into a useful form
- Transform features into feature vectors
- Trained into models
- Iterate workflows
Offline Development Datacenters

Kafka

Azkaban

Hadoop for ETL

Azkaban

Hadoop for development
Offline Production Datacenters

Staging Voldemort Read-

Azkaban

Hadoop for production
Egress

Back online!
Results

• Usually pushed to other systems (Back online or for further consumption)
Three main mechanism

- Key-Value
- Streams
- OLAP
Voldemort

- Based on Amazon’s Dynamo
- Distributed and Elastic
- Horizontally scalable
- Bulk load pipeline from Hadoop
- Simple to use

Reference: Slides of The big data ecosystem at LinkedIn, presented at SIGMOD 2013
Stream output performed by Kafka

- Implemented using Hadoop API
- Each MR slot acts as a Kafka producer
• Automatically generates corresponding Azkaban job pipelines.
• Small cubes are multidimensional arrays of tuples
• Each tuple is combination of dimension and measure pairs
• Output cubes to Voldemort as a read-only store.
Applications
Future Work
• MapReduce for processing large graphs

• Streaming System for near line low-latency data processing