

# Data Engineering In Depth

## From Beginner to Professional

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<sup>1</sup>Big Data & Analytics Department, Epam Systems

The Definitive Guide to Big Data Engineering Tasks

# Course Introduction

# Course Target



# Learning Objectives

- Understand the data management life-cycle.

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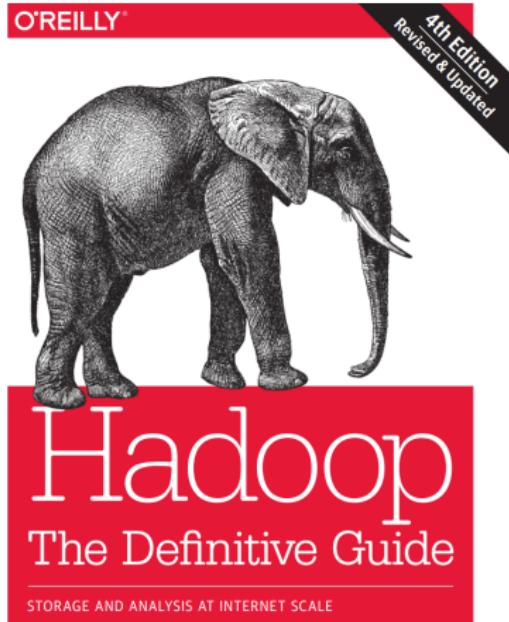
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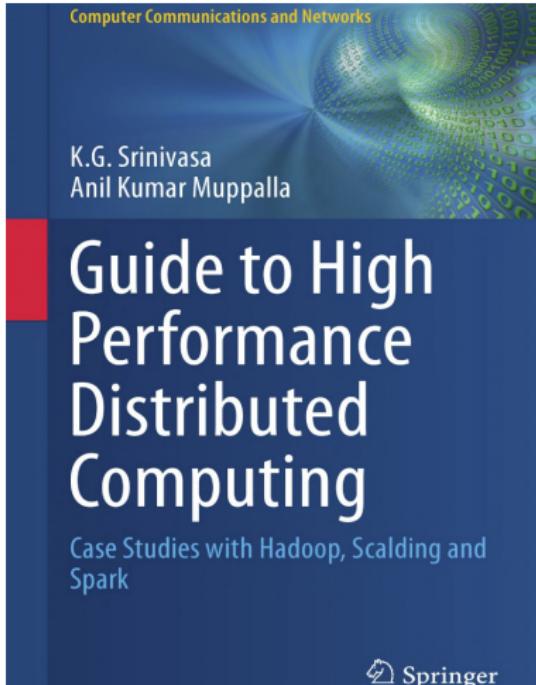
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- Kafka: The Definitive Guide by Todd Palino, Gwen Shapira, Neha Narkhede.
- Guide to High Performance Distributed Computing: Case Studies with Hadoop, Scalding and Spark (Computer Communications and Networks)  
2015th Edition

# Textbooks-2



Tom White



# Textbooks-3

O'REILLY®



## Learning Spark

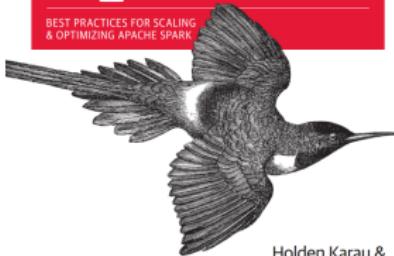
LIGHTNING FAST DATA ANALYSIS

Holden Karau, Andy Konwinski,  
Patrick Wendell & Matei Zaharia

O'REILLY®

## High Performance Spark

BEST PRACTICES FOR SCALING  
& OPTIMIZING APACHE SPARK



Holden Karau &  
Rachel Warren

O'REILLY®

## Kafka The Definitive Guide

REAL-TIME DATA AND STREAM PROCESSING AT SCALE



Neha Narkhede,  
Gwen Shapira & Todd Palino

# Ugly but important

- User stories or technical discussions are not related to any of my current work or my previous companies.
- I am working at EPAM Systems. My company approved me for doing this online course public but the materials are not reviewed or assessed by my company. It is on my own responsibilities.

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# Introduction To Data Management and Data Warehouse

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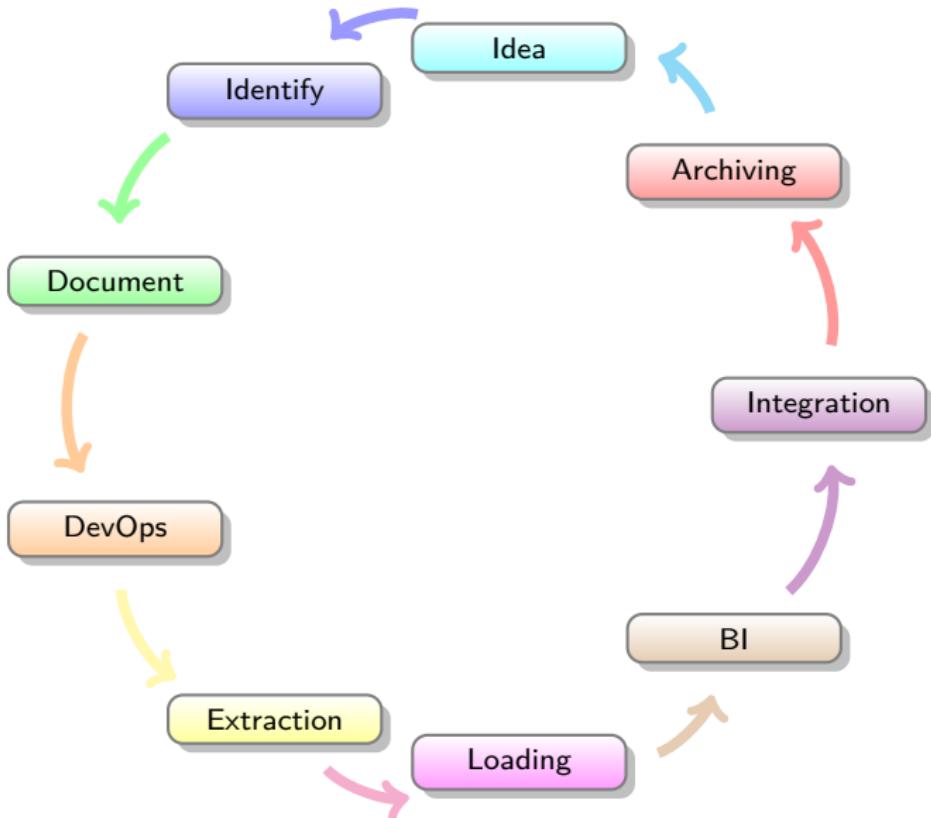
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# Data Management

- Data are a product.
- Data product has a life-cycle as following (simplified):
  - **Question**, Idea, or service.
  - **Identifying** the source of information and the data type ex: (text, images, videos, audio, or sensors).
  - **Document** all details regarding the data including quality, security, efficiency, and access (consideration during the cycle).
  - Delivery automation (Tools and Process) AKA **DevOps** cycle.
  - **Extraction** Process (collection).
  - **Transformation** ex: (cleansing, Apply business logic, Organize).
  - **Loading** or store the transformed data based on our usage or use case.
  - Business Intelligence (**BI**) or data discovery (continues process).
  - **Integration** and publishing.
  - Data retention or **archiving** process ex: (Hot or Cold storage).

# Data Management Life-Cycle



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  - Integration.
  - Applying analytical functions.
- Vendors who are working to solve the above challenges creating their own product of DWH and their ultimate work is to optimize the above points.

# Motivation to Data Warehouse (DWH)

## Definition (What is Data Warehousing?)

A DWH is defined as a technique for collecting and managing data from varied sources to **provide meaningful business insights**. It is a blend of technologies and components which aids the strategic use of data.<sup>1</sup>

- The DWH is not a product but an environment.
- It is a process of transforming data into information and making it available to users in a **timely manner** to make a difference.
- It is an architectural construct of an information system which provides users with current and historical decision support information which is difficult to access or present in the traditional operational data store.
- The DWH is the core of the BI system which is built for data analysis and reporting.

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<sup>1</sup>The definition mentioned in this slides copied from guru99.com

# Motivation to Data Warehouse

Data warehouse system is also known by the following names:

- Decision Support System (DSS).
- Business Intelligence Solution.
- Executive Information System.
- Management Information System.
- Analytic Application.
- Data Warehouse.

The real concept was given by Inmon Bill. He was considered as a father of the DWH. He had written about a variety of topics for building, usage, and maintenance of the warehouse & the Corporate Information Factory

# Motivation to Data Warehouse

## Types of Data Warehouse

**Enterprise Data Warehouse (EDWH)** It provides decision support service across the enterprise. It offers a unified approach for organizing and representing data (DWH Model). It offers data classifications according to the subject with privileges policy.

**Operational Data Store (ODS):** is a central database that provides an up-to-date (real-time) data from multiple transnational systems for operational reporting into a single DWH.

**Data Mart:** A data mart is a subset of the data warehouse. It specially designed for a particular line of business, such as sales, finance, sales or finance. In an independent data mart, data can collect directly from sources.

# DWH vs ODS vs Data Mart

Metric	DWH	ODS	Data Mart
Latency	Day -1	Real-time	Day -1
Data level	Transnational	Transnational	Summary
Historical	Long-term	Snapshot	Aggregated Long-Term
Size	TB/PB	GB	GB/TB
Orientation	Multi sources	Multi sources	Product
Business Units	Multi organizational units	Product team	Business team

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- Data warehouse designed to solve the **huge amount of data**.
- Most of DWH can't solve the online transactions similar to the transaction DB.
- Transactions databases have a performance issue while handling a huge amount of data. So, analysis of a huge amount of data (including historical data) we used DWH for this purpose. On the other hand Transactions DB used for online or short historical data based on product type and requirements.

# DWH vs Operational databases

Metric	Transactions DB	DWH
Volume	GB/TB	TB/PB
Historical rows	Short-term <1000M	Long-Term 1000M>
Orientation	Product	Subject or multi products
Business Units	Product team	Multi organizational units
Normalization	Normalized	Not required (De-normalized in many use cases)
Data Model	Relational	Star Schema or Multi-dim
Intelligence	Reporting	Advanced reporting and Machine Learning
Use cases	Online transactions & operations	Centralized storage (360°)

# Transnational DB Use cases



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# DWH Use cases



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# DWH Use cases



User stories Telecom company.

It has a CRM System backend database reporting the sales. vs Another backend database contains the CRM, Telecom signaling data, IN charging system, Billing

Decision is related to sales or CRM. Decision is related to company strategies.

Analytical model checking the fraud which require a CRM data with customer locations from signaling with Billing details from CAR table.

managing risk of the project in Transaction vs DWH

data model comparison

# DWH Characteristics

some details about hot vs cold storage,

# Cold storage vs Hot storage

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# Data Encoding and Formats

- Any Big Data solution working based distributed systems.

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- Any Big Data solution working based distributed systems.
- What is distributed systems in brief?

# Introduction To Distributed Systems

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- Partitioning and its usage in distributed systems .

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# Spark Datasets/Dataframe

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# Spark on Production

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# Spark For Batch Processing

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# Building custom input and output connector using Spark

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# Spark Streaming

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# Spark using other Programming Languages

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# Spark For Data Scientist

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# Spark Graph Dataframe/Graphx

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# Tuning your Spark Jobs

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## Real World Applications

# Massaging Systems

# Data Orchestration

# NOSQL

# Elastic

# Appendix

# Appendix A- Shell Programming

- Any Big Data solution working based distributed systems.

# Appendix A- Shell Programming

- Any Big Data solution working based distributed systems.
- What is distributed systems in brief?

## Appendix B- Java Programming

- Any Big Data solution working based distributed systems.

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- Any Big Data solution working based distributed systems.
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## Appendix C- Scala Programming

- Any Big Data solution working based distributed systems.

## Appendix C- Scala Programming

- Any Big Data solution working based distributed systems.
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## Appendix D- SQL Programming

- Any Big Data solution working based distributed systems.

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## Appendix E- Oozie Orchestration

- Any Big Data solution working based distributed systems.

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## Appendix F- DWH Concepts and Data Modeling Design

- Any Big Data solution working based distributed systems.

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## Appendix G- Machine Learning Concepts Data Engineers

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## Appendix H- Docker for Data Engineers

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