(Big) Data Engineering In Depth

From Beginner to Professional

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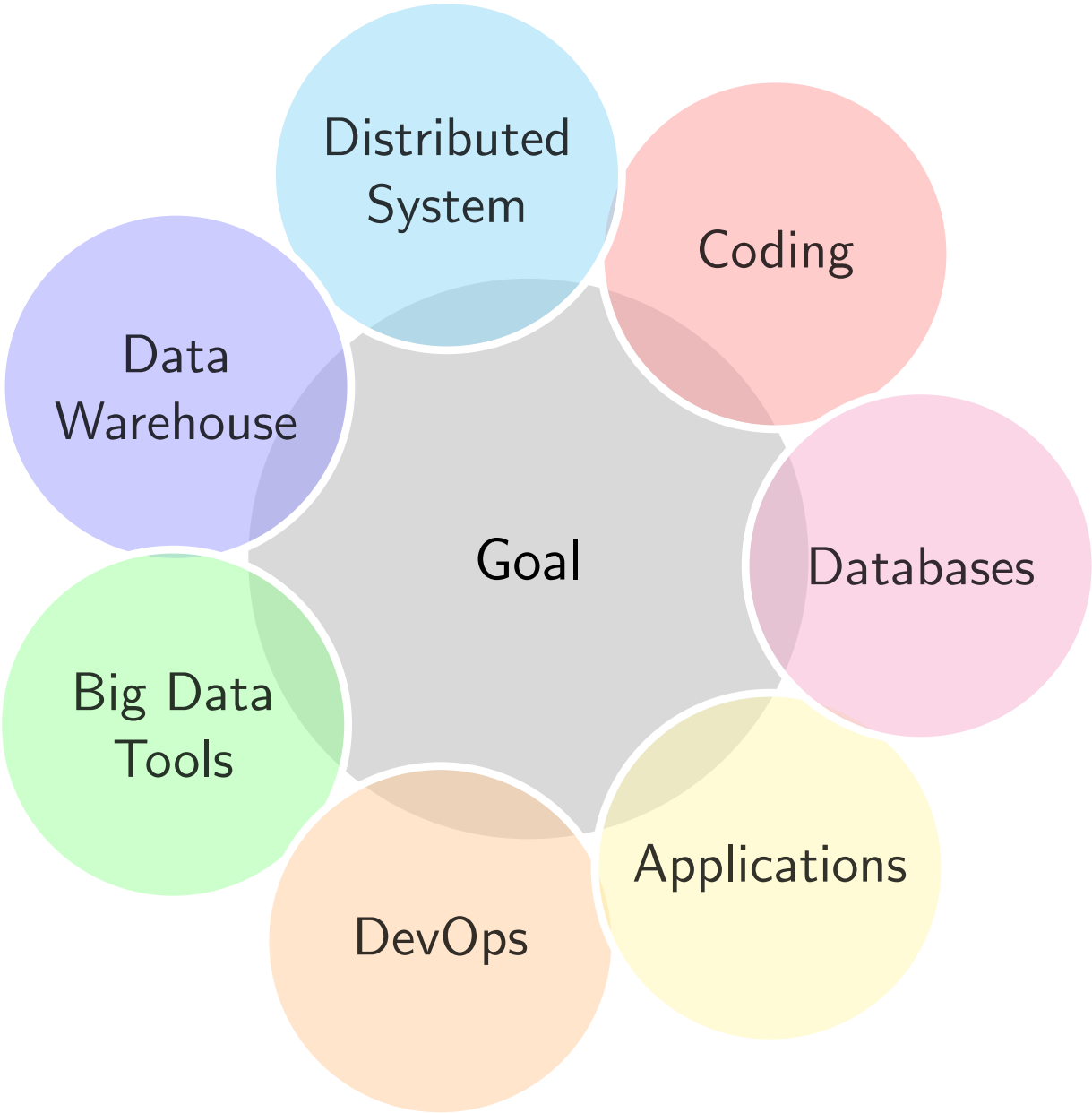
[1]Big Data & Analytics Department, Epam Systems

The Definitive Guide to Big Data Engineering Tasks

Course Introduction

Course Target



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- Build and scale your data product.

Audience: Who Should Take This Course?

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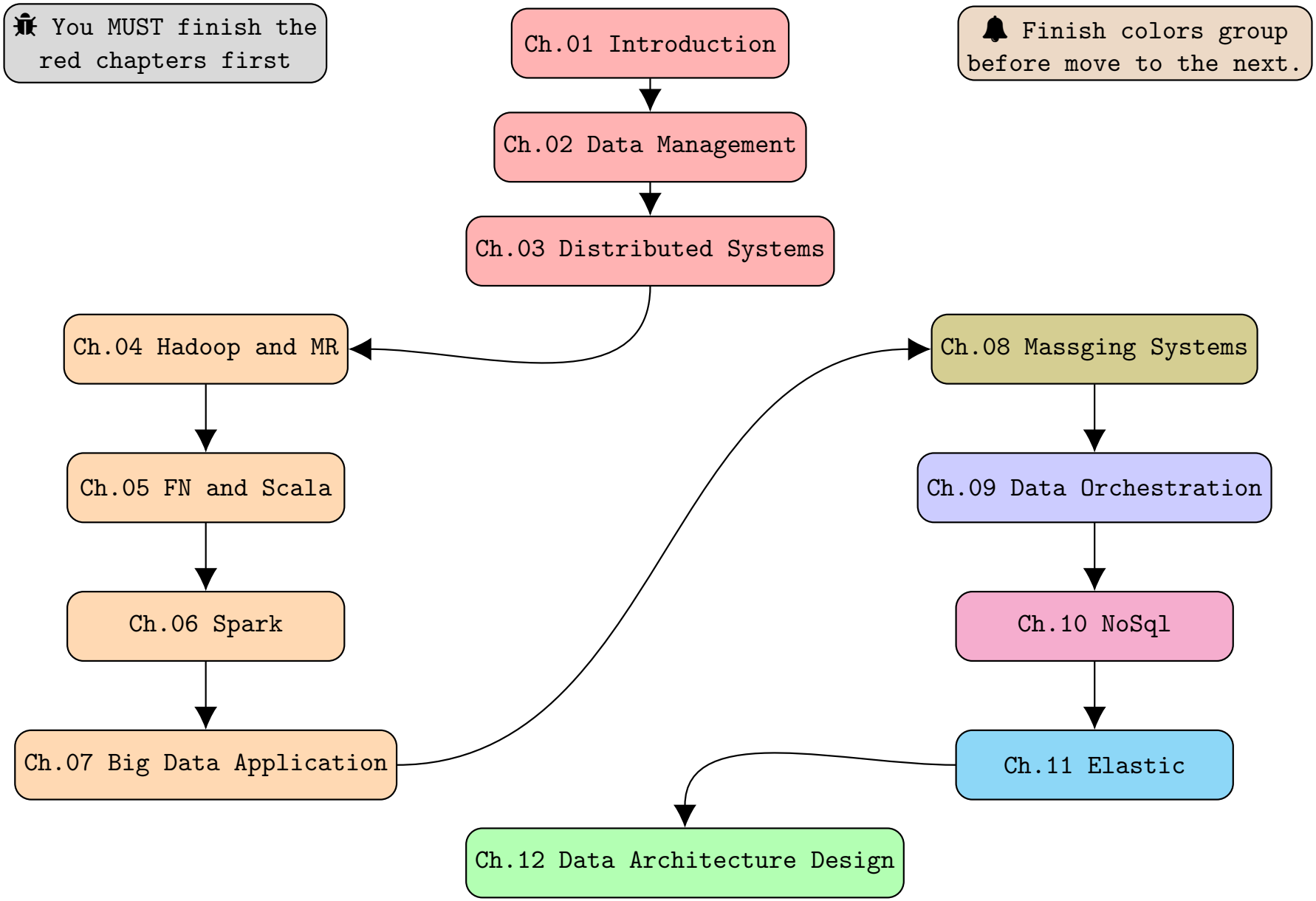
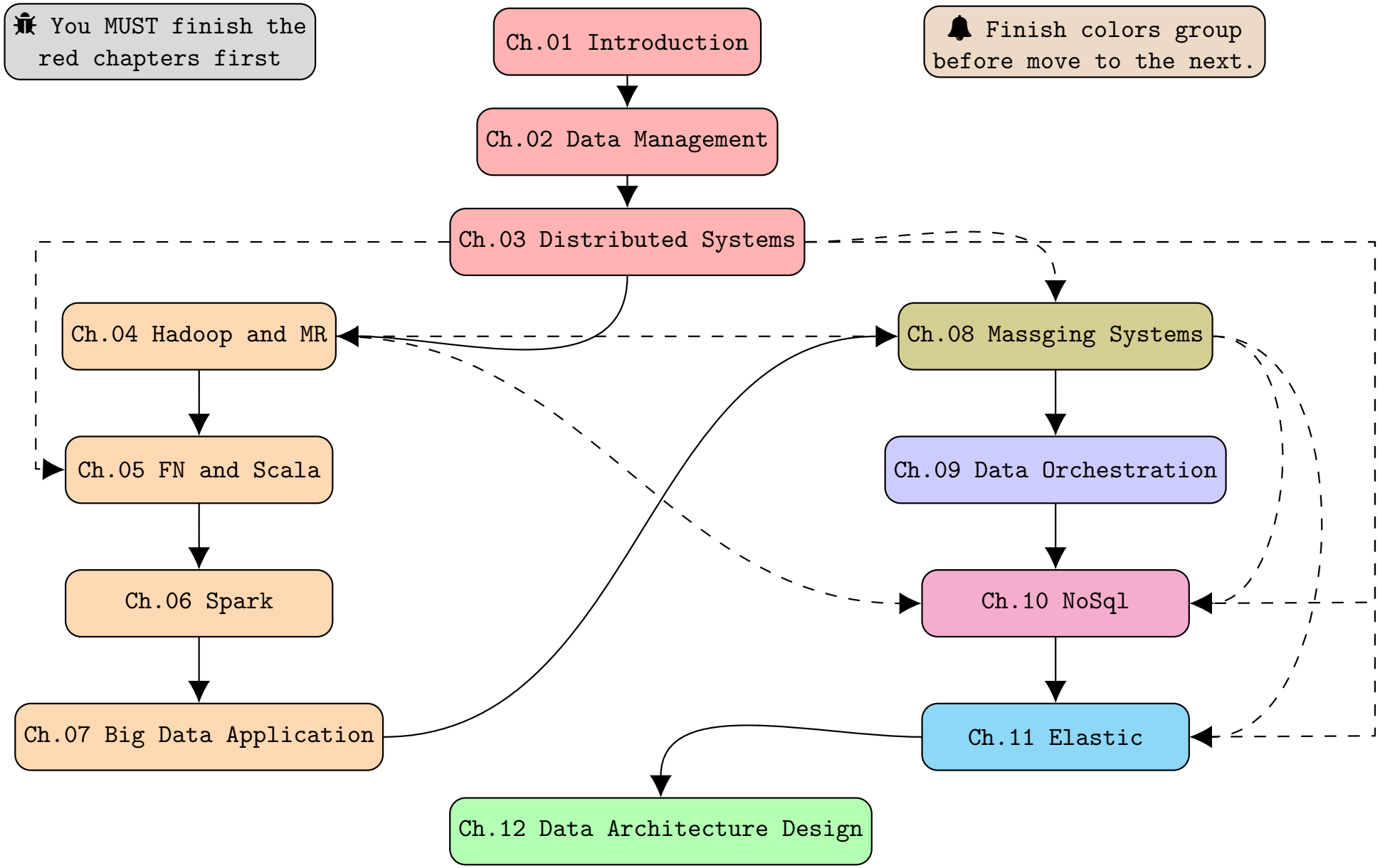


Chapter Dependencies (Jump Out Path)



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- Full project code.

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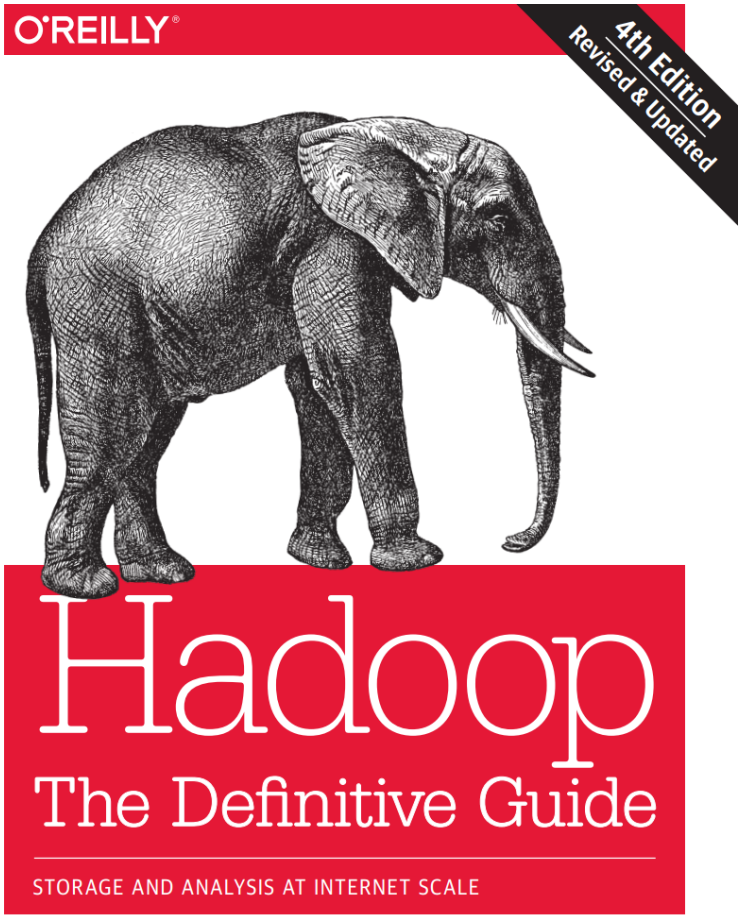
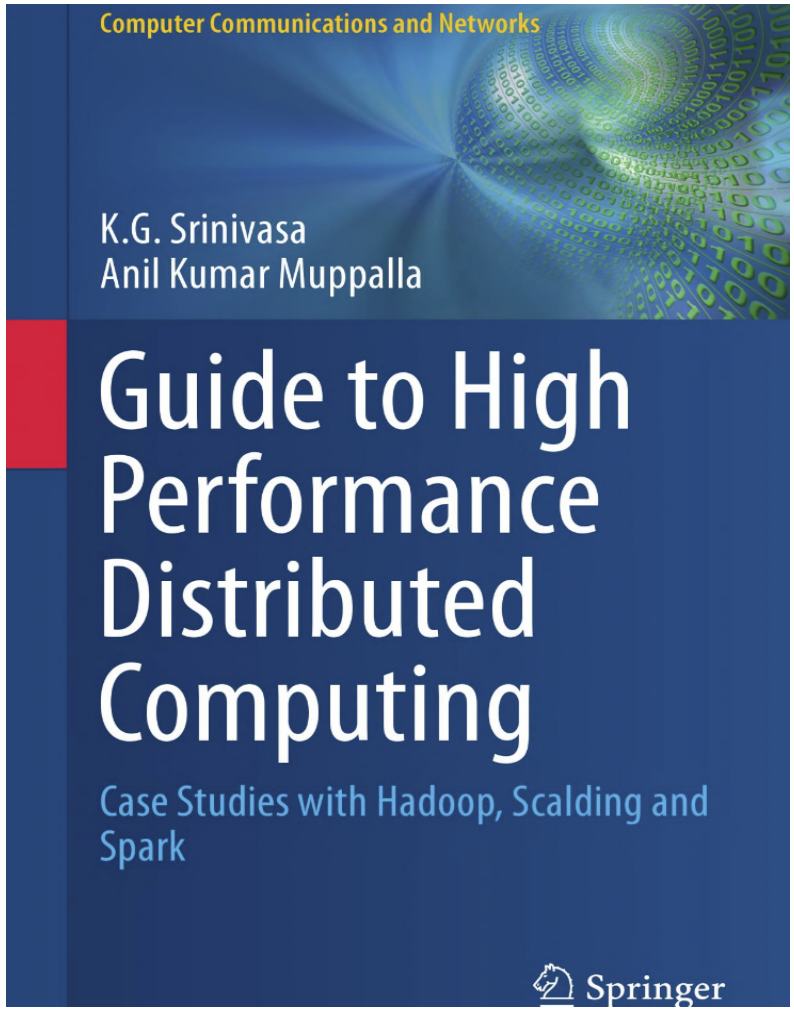
- Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems 1st Edition by Martin Kleppmann

Textbooks-2


O'REILLY
4th Edition
Revised & Updated
Hadoop
The Definitive Guide
STORAGE AND ANALYSIS AT INTERNET SCALE
Tom White


Computer Communications and Networks
K.G. Srinivasa
Anil Kumar Muppalla
Guide to High Performance Distributed Computing
Case Studies with Hadoop, Scalding and Spark
Springer

Textbooks-3


CATEGORY THEORY
FOR PROGRAMMERS
Bartosz Milewski


O'REILLY
High Performance
Spark
BEST PRACTICES FOR SCALING
& OPTIMIZING APACHE SPARK
Holden Karau &
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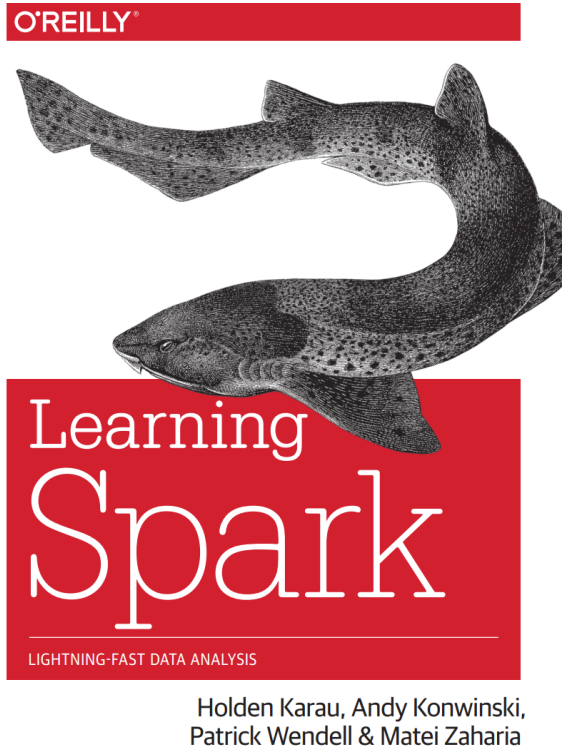
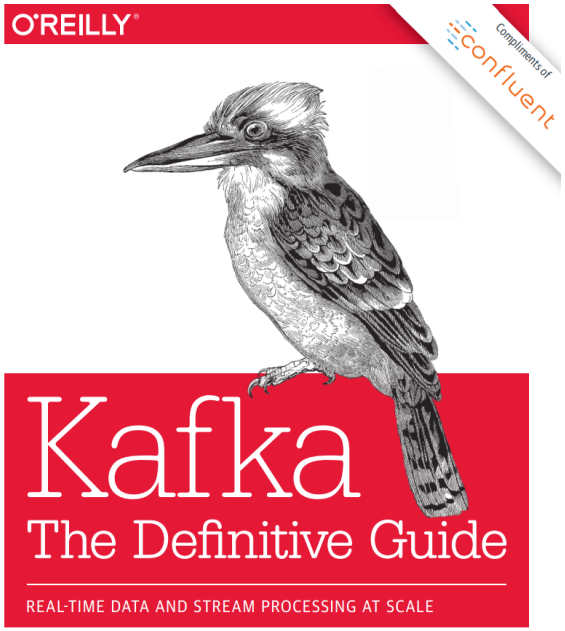
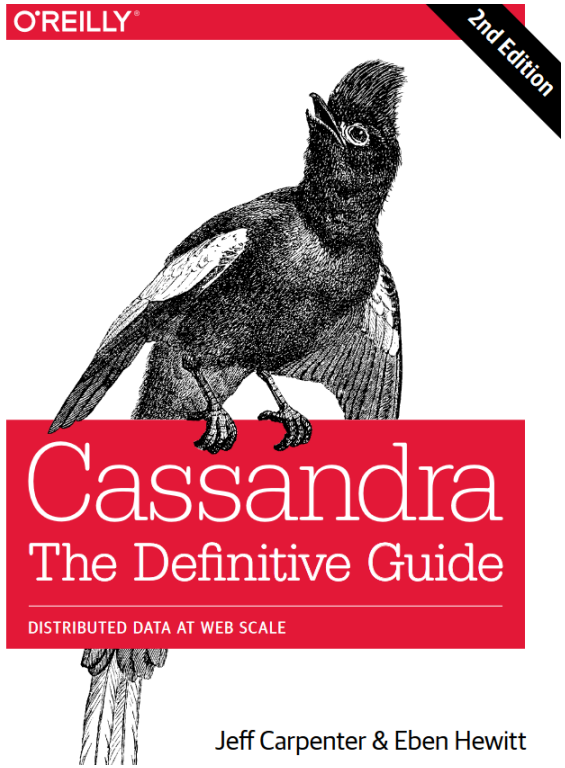

O'REILLY
Learning
Spark
LIGHTNING-FAST DATA ANALYSIS
Holden Karau, Andy Konwinski,
Patrick Wendell & Matei Zaharia

Textbooks-4


O'REILLY
Compliments of
confluent
Kafka
The Definitive Guide
REAL-TIME DATA AND STREAM PROCESSING AT SCALE
Neha Narkhede,
Gwen Shapira & Todd Palino


O'REILLY
2nd Edition
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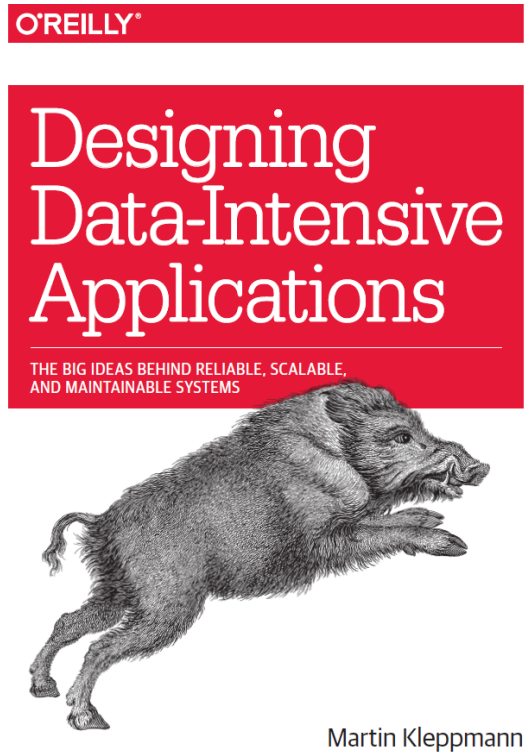
DISTRIBUTED DATA AT WEB SCALE
Jeff Carpenter & Eben Hewitt


O'REILLY
Designing
Data-Intensive
Applications
THE BIG IDEAS BEHIND RELIABLE, SCALABLE,
AND MAINTAINABLE SYSTEMS
Martin Kleppmann

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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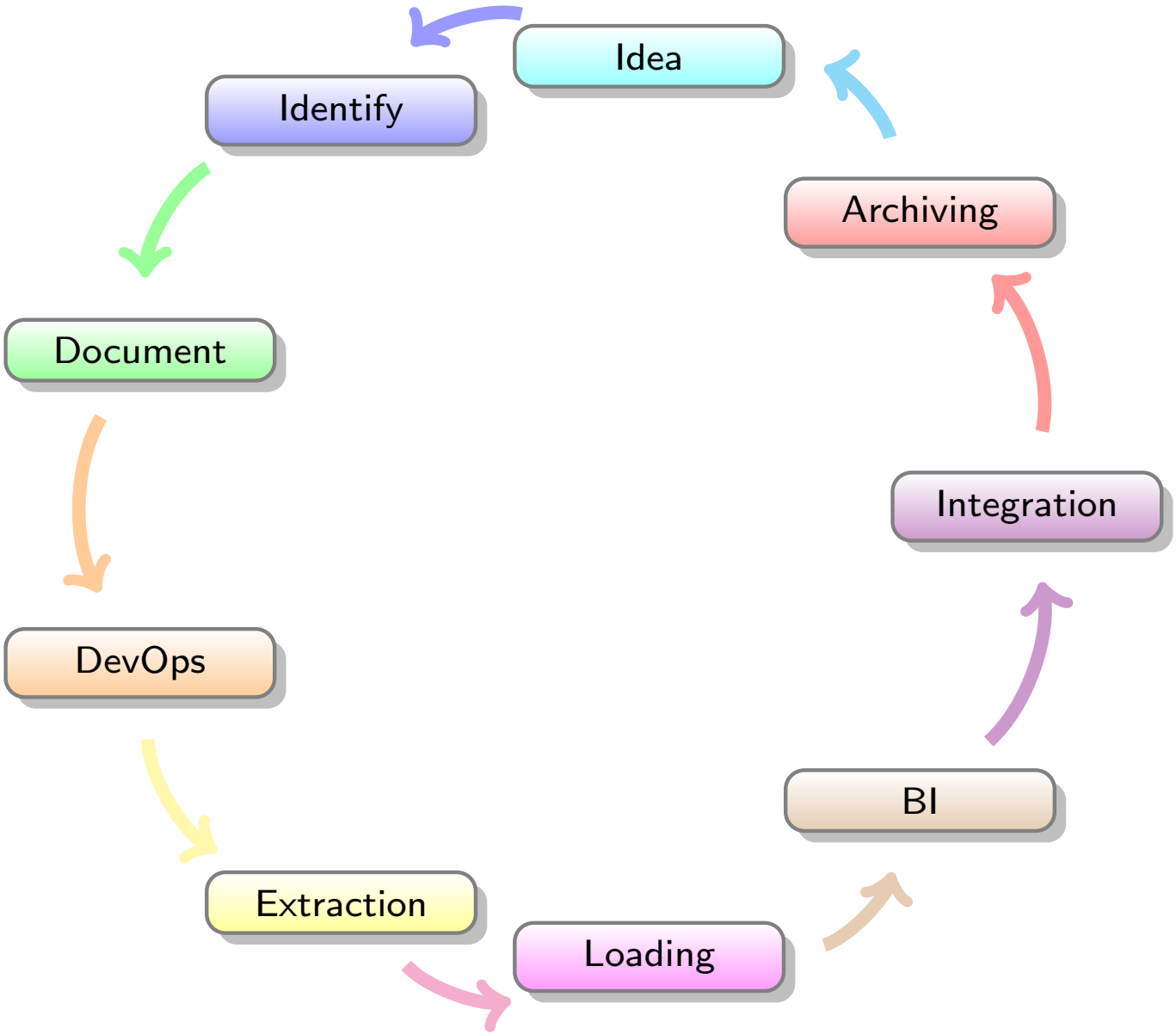
Data Management

- 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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  - Performance.
  - 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.[1]

- The DWH is not a product but an environment.
- It is a process of transforming data into information and make 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.

[1] 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

DWH vs Operational databases

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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

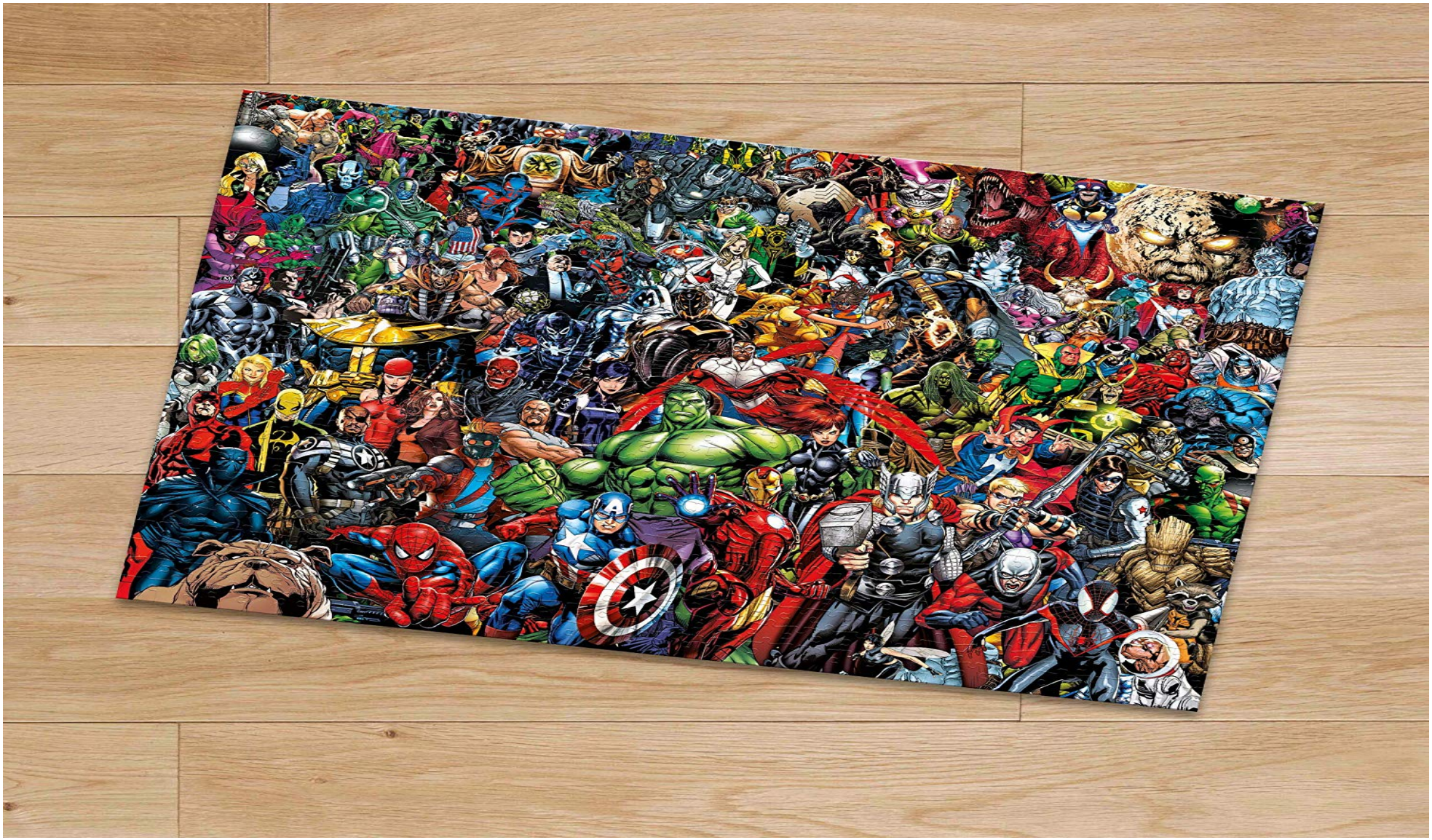
Metric	Transactions DB	DWH
Volume	GB/TB	TB/PB
Historical	Short-term	Long-Term
rows	¡1000M	1000M¿
Orientation	Product	Subject or multi products
Business Units	Product team	Multi organizational units
Normalization	Normalized	Not required (De-normalized in many use cases)
Data Model	Relational	Star Schema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

Transnational DB Use cases

Transnational DB Use cases

DWH Use cases

DWH Use cases



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

some details about hot vs cold storage,

Data Encoding and Formats

- Any Big Data solution working based distributed systems.

Data Encoding and Formats

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

Data Modeling Design

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- Replication and its usage in distributed systems.

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- Partitioning and its usage in distributed systems .

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Design Simple Distributed System

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Introduction to Hadoop and Map-Reduce

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- Introduction to Hadoop and its echo-systems.

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- Why we need Hadoop?

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- Why we need Hadoop?
- Understand the concept of HDFS and Map-Reduce.

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- Developing Map-Reduce applications.

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- Using HiveQL over Map-Reduce.
- Hadoop advantages and disadvantages with use cases?

Hadoop Architecture

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Hadoop I/O

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Hadoop I/O

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

Processing

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Map-Reduce

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Map-Reduce Components

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Word-Count Example

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Pig

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Hive

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ZooKeeper

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Functional Programming

Spark Framework

Spark Framework: Spark Philosophy towards the Engine and the Programming languages

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Spark Framework: Spark Basics

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Spark Basics

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Spark Programming using RDDs

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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

Data Architecture Design

Appendix

Appendix A- Shell Programming

- Any Big Data solution working based distributed systems.

Appendix A- Shell Programming

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Appendix B- Java Programming

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Appendix C- Scala Programming

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Appendix D- SQL Programming

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Appendix E- Oozie Orchestration

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Appendix F- DWH Concepts and Data Modeling Design

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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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