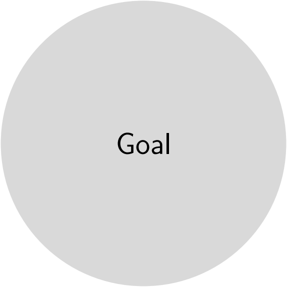
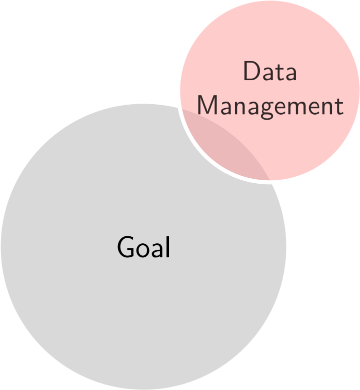
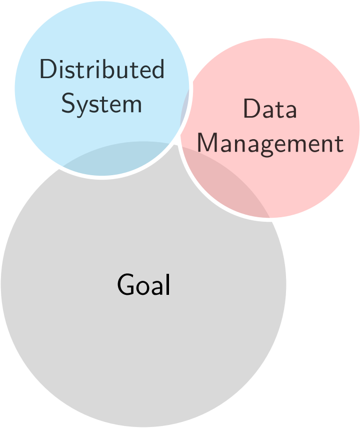
Course Introduction

Course Target




Data
Management
Goal

Course Target



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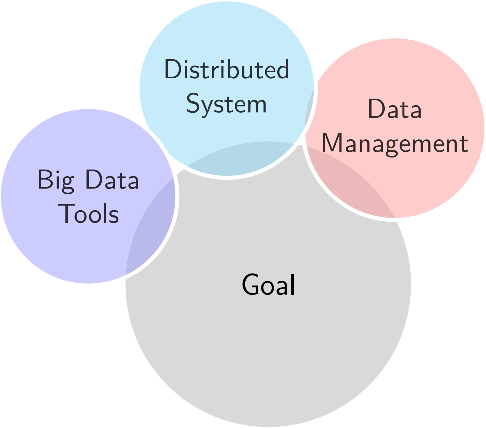
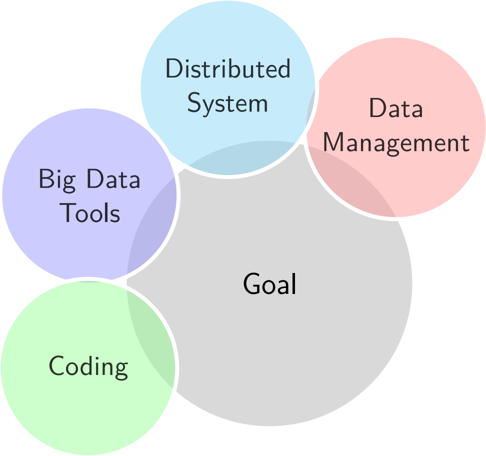
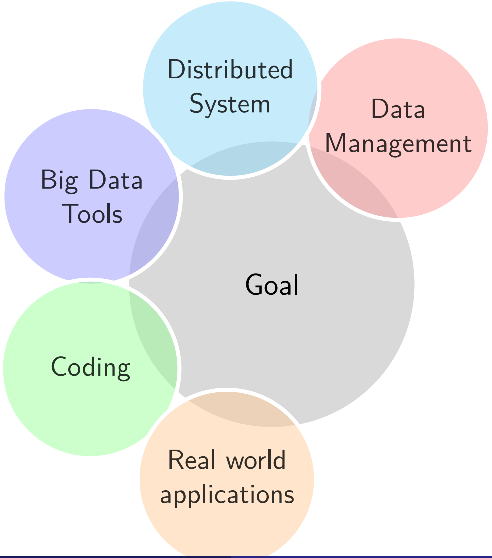
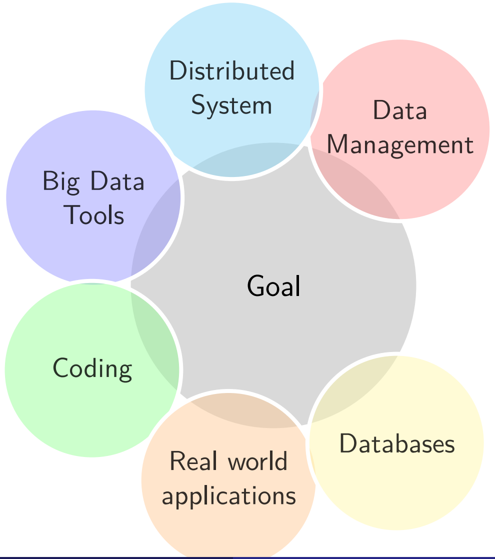


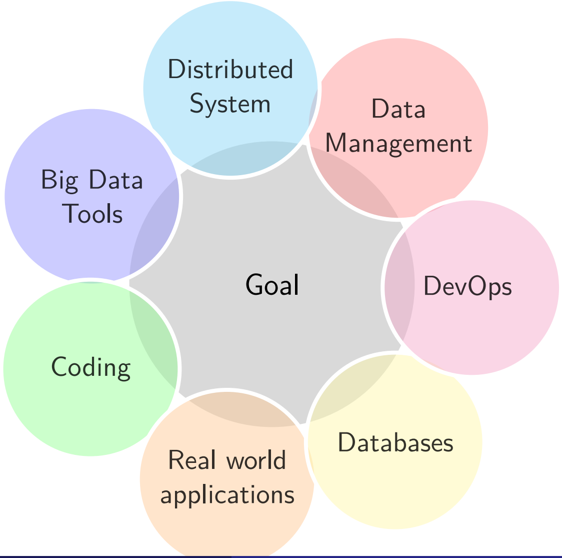

Distributed System
Data Management
Big Data Tools
Goal
Coding

Course Target




Distributed
System
Data
Management
Big Data
Tools
Goal
Coding
Databases
Real world
applications

Course Target



Learning Objectives

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Audience: Who Should Take This Course?

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- Business or entrepreneur who needs to get more information about how to build or manage a data product.

Getting max benefit from this course

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Take the course advantage

- Follow the videos order as described.

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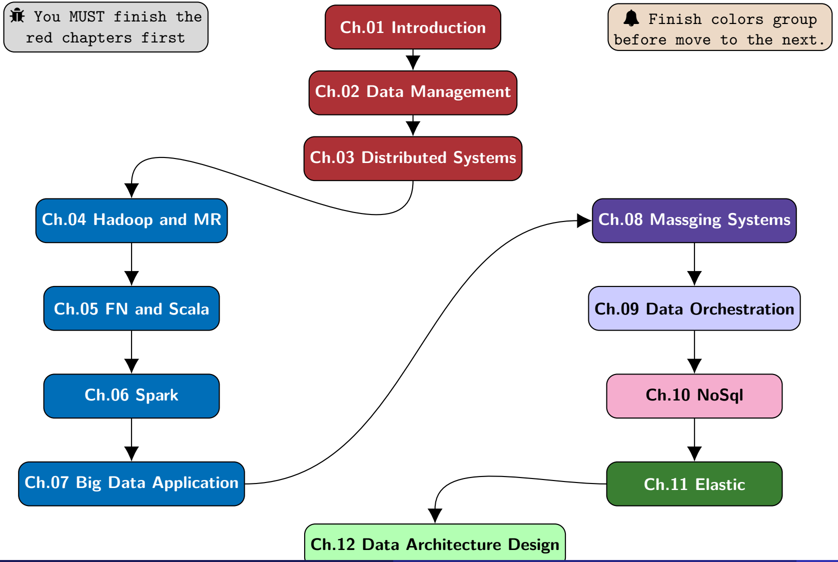
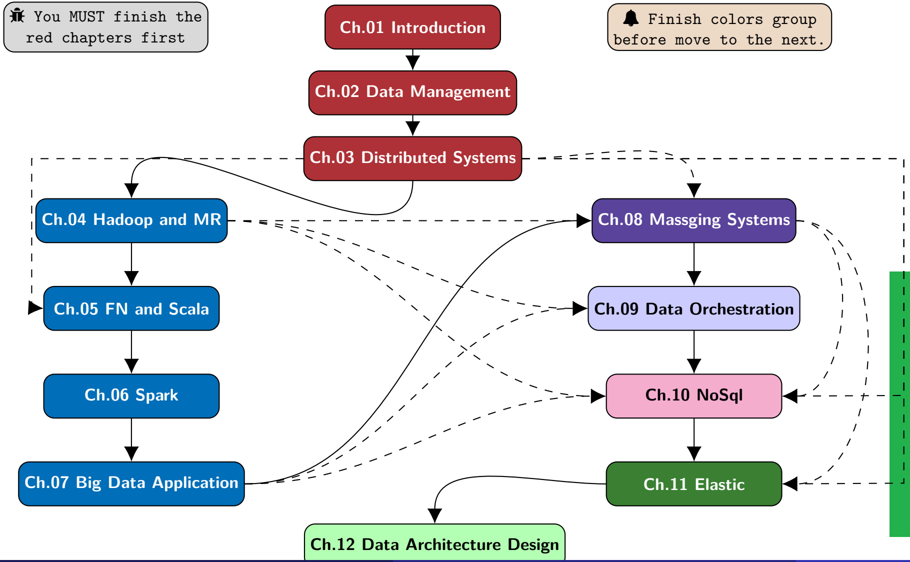
Chapter Dependencies



Chapter Dependencies (Jump Out Path)



Assignments and Labs

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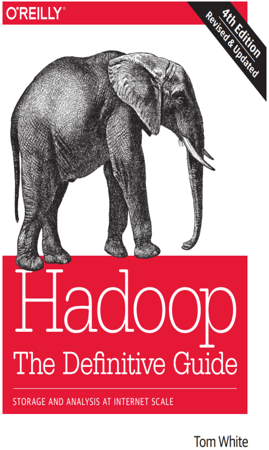
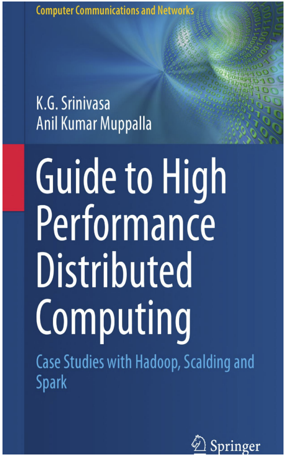
Textbooks-1

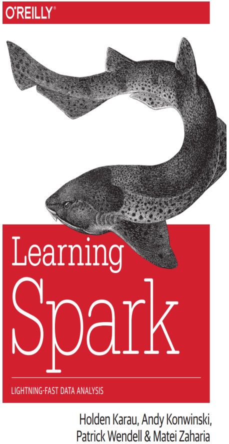

O'REILLY
4th Edition
Revised & Updated
Hadoop
The Definitive Guide
STORAGE AND ANALYSIS AT INTERNET SCALE
Tom White


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

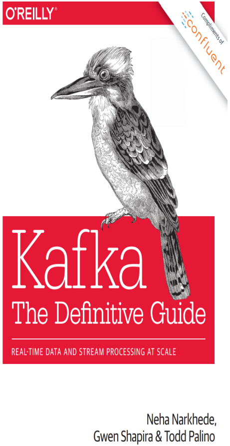
Textbooks-2

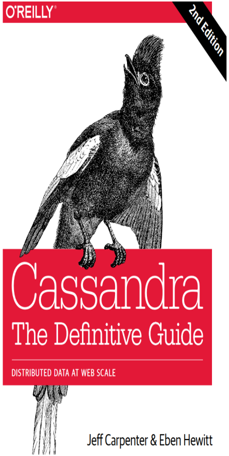

Functional Programming
IN
Scala
Paul Chiusano
Rúnar Bjarnason
Foreword by Martin Odersky
MANNING

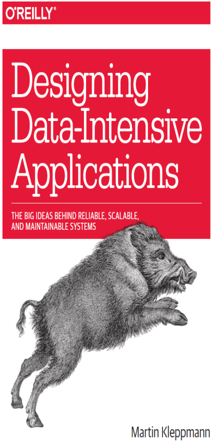

O'REILLY
High Performance
Spark
BEST PRACTICES FOR SCALING
& OPTIMIZING APACHE SPARK
Holden Karau &
Rachel Warren


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

Textbooks-3


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
Cassandra
The Definitive Guide
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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Table of Contents VIII

Introduction To Data Management and Data Warehouse

- Be familiar with data management life-cycle.

Chapter Objectives

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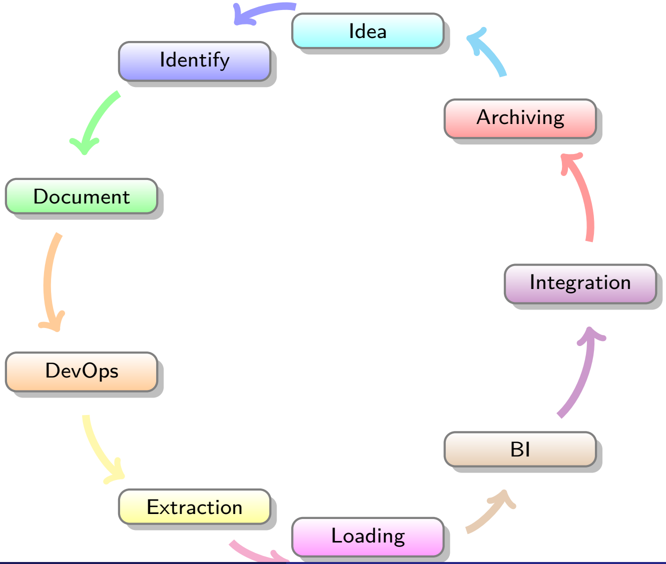
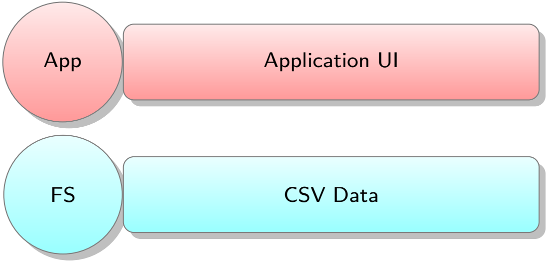
    - Data retention or **archiving** process ex: (Hot or Cold storage).

Data Management Life-Cycle



Data Abstraction

Motivation to Data Layers (Use Case)



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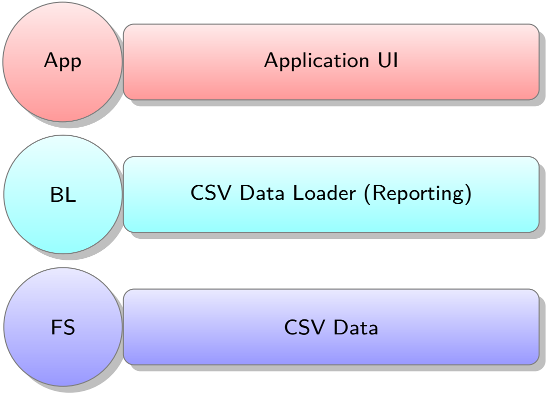

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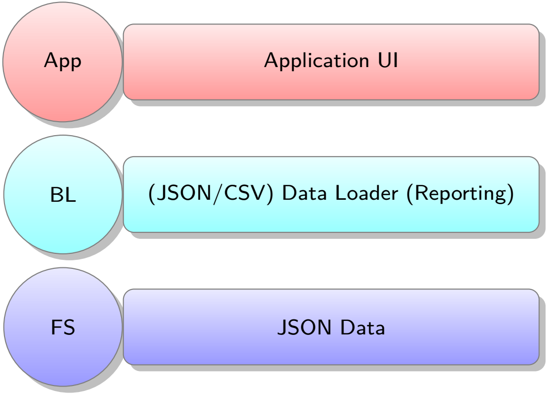

Motivation to Data Layers (Use Case)

App	Application UI
DBMS-H	Ready prepared layer for each department (Reporting)
DBMS-M	Logical part to prepare for the data structure and the relation between the data
DBMS-L	Storage and Data format related stuff + Data indexing and searching algorithms

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- To answer these questions you need to understand the **data layers**.

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- The process of **hiding** irrelevant details from developer (user) is called data **abstraction**.

Data Layers (Abstraction)

Definition

Data Abstraction and Data Independence: DBMS comprise of complex data-structures. In order to make the system efficient in terms of retrieval of data, and reduce complexity in terms of usability of users, developers use abstraction i.e. hide irrelevant details from the users. This approach simplifies database design.

- There are 3 levels of data abstraction.

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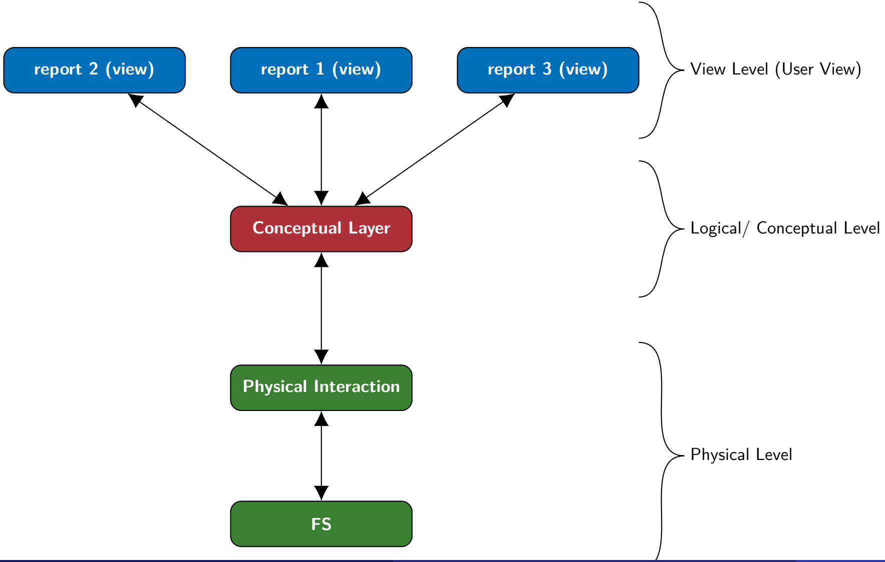

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  - It allows you to modify the lowest level (Physical part) without any change in the logical schema. These change could be

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    - Modifying indexes.
    - Change the compression algorithm or hashing technique.

Physical level

Example

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Physical level

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  - Usually this layer abstracted from the programmers.

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- **Logical level (Conceptual)**:

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  - The programmers design this level based on the business knowledge and the requirements.

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  - Not all the views is extended to all users and there is an authentication based on the category.

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View level

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- We might hide information about some products based on the teams or users.

Let's answer our previous the question, How can we solve data challenges?

Data solution thinking (Summary)

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    - When we need to add/remove/create new reports it is usually view layer.
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    - Update the data type or the existing relation which could help to fix some data or performance issues.

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    - When our problem is hardly or impossible to be fix by obtimize the query (view)/ logical layer it is time for physical change.
    - If we need to change your storage/compression/structure/access technique.
    - If we need to change the data orientation structure from row to column or key-value storage, It is time to change the physical layer.

From Operational DB to DWH

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- There are some challenges facing the people who work on data management backend:
  - 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.

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

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- The DWH is the core of the BI system which is built for data analysis and reporting.

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.

Differences Between DWH and Operational DB

DWH vs Operational databases

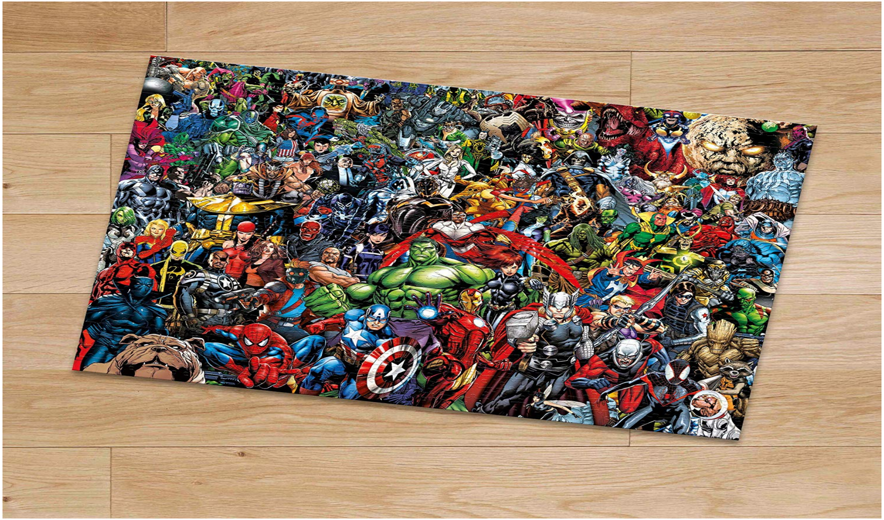
Metric	Transactions DB	DWH
Volume	GB/TB	TB/PB
Historical	Short-term	Long-Term
rows	<1000M	1000M>
Orientation	Product	Subject or multi products
Business Units	Product team	Multi organizational units
Normalization	Normalized	Not required (De-normalized in many use cases)
Data Model	Relational	Star Schema 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

Types of DWH

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

Use Cases of Operational DB vs DWH

Use case (Operational DB)

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  - CRM team can report their sales and customer activities from their database.
  - Product owner can take a decision based on their system backend reports.

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  - The decision from the DHW is a **global and strategical decision.**
  - If the company needs to build a machine learning model which needs data from different sources. They need to load the data from a centralized database rather than read each source alone.

Use case (DWH)

The Full picture required a DWH. However, we still need the other operational databases for product development perspective.

Use case (ODS)

- Why do we need the ODS?

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- Why do we need the ODS?
- How does it fit in our system?

Use case (ODS)

XTec has a call center system which handles the customer inquiries. This system requires the some data related to usage, customer information, billing details to be calculated and accumulated in **real-time** to be able to give the customer the right answer for his inquires.

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  - It needs specific information from different source systems.
  - It requires to track the source system database changes or update in real-time.
  - It's functionality is based on the aggregate data not the transactions for example (It needs the total outgoing calls till time or it needs the total charging amounts from prepaid or the available limits from billing if it is postpaid).

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- ODS uses the real-time aggregations to support the online systems from different source systems.

DWH Characteristics

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some details about hot vs cold storage,

DWH Architecture Overview

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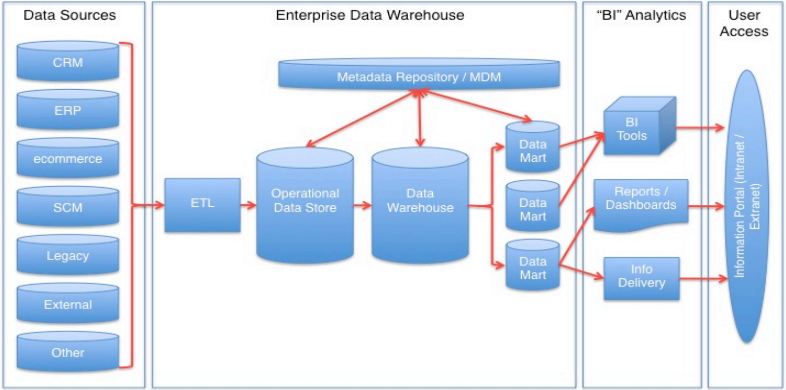

Figure: taken from XXXX

Data Models

What is data model?

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- It describes how application (report) API data manipulation.
- It describes the conceptual design of a business or an application with its flow, logic, semantic information (rules), and how things are done.
- It refers to a set of concepts used in defining such as entities, attributes, relations, or tables.

What is data model?

Data model is not

- a science.
- a static design for each organization.
- a type of database.
- a new invention which needs to be done for each project.

Data model is

- an engineering design practices.
- a general concepts which lead to build full architecture.
- different based on the use case and the database type.
- customizable and we can utilize some of ready built architecture.
- implementing using different ways.
- affecting the information reporting performance and ways.

Why does data models are important?

- Data models are currently affecting software design.
- It decides how engineers will think about the problem they are solving.

Data Model Design

Data Model Design vs Implementation

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  - Hire a contractor to build (implement the design) the home.
  - This phase will implement the design but it also include some detail related to the actual way to build the tools and the material. (Physical Design)

Cold storage vs Hot storage

some details about hot vs cold storage,

Data Encoding and Formats

Data Models

- Any Big Data solution working based distributed systems.

Data Models

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

Further Readings and Assignment

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Chapter Objectives

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Further Readings and Assignment

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Processing

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- What is distributed systems in brief?

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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Further Readings and Assignment

Functional Programming

Why functional programming commonly used in distributed systems?

Introduction to Scala

Further Readings and Assignment

Spark Framework

Spark Philosophy towards the Engine and the Programming languages

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

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

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Spark Basics

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Spark Framework: Spark Basics

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Spark Programming using RDDs

Spark RDD

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Spark Working With Key/Value Pairs

Spark Programming using RDDs

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Spark Programming using RDDs

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Spark Datasets/Dataframe

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Spark SQL

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Spark Datasets/Dataframe

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Dataframes/Datasets vs. 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

Building custom input and output connector using Spark

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Spark Streaming

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Spark using other Programming Languages

PySpsark for Python Geeks

Spark using other Programming Languages

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RSpark for R Geeks

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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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Spark Graph Dataframe/Graphx

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Tuning your Spark Jobs

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Further Readings and Assignment

Real World Applications

Big Data Development Life Cycle

Template Concept for Data Engineering

Template for ETL Application

Template for QA

Template for Streaming Applications

Template for Machine Learning Applications

Further Readings and Assignment

Massaging Systems

Motivation

Massaging Systems Architecture

JMS as an example

Introduction to Kafka

Kafka Architecture

Kafka Topics

Partitions

Kafka Producers

Kafka Consumers

Kafka Connector

Kafka Custom Connectors

Kafka Configuration

Kafka Configuration Optimizations

Kafka Operations

Kafka Integration with Enterprise tools

Further Readings and Assignment

Data Orchestration

Motivation

Enterprise vs Open source tools

Open source tools (Oozie as an Example)

Enterprise source tools

How to choose the right tool?

Further Readings and Assignment

NOSQL

Introduction to NoSQL Databases.

Cassandra

Why Cassandra?

Introducing Cassandra

The Cassandra Data Model

Architecture

Reading and Writing Data

Integrating Hadoop

Further Readings and Assignment

Elastic

Further Readings and Assignment

Data Architecture Design

Further Readings and Assignment

Appendix

Appendix A- Shell Programming

- Any Big Data solution working based distributed systems.

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Appendix B- Java Programming

- Any Big Data solution working based distributed systems.

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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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