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Lecture 1.2
Classification of digital data

School of Computer Science & Engineering

AY: 2021-2022

Classification of digital data

Recap of previous Lecture

Classification of digital data

Topic of the Lecture

TOPIC OF THE LECTURE

- Introduction to Digital Data
- Structured Data
- Semi-structured Data
- Unstructured Data
- Structured Vs. Unstructured Data
- Characteristics of Data

Classification of digital data

Introduction to Digital Data

CLASSIFICATION OF DIGITAL DATA

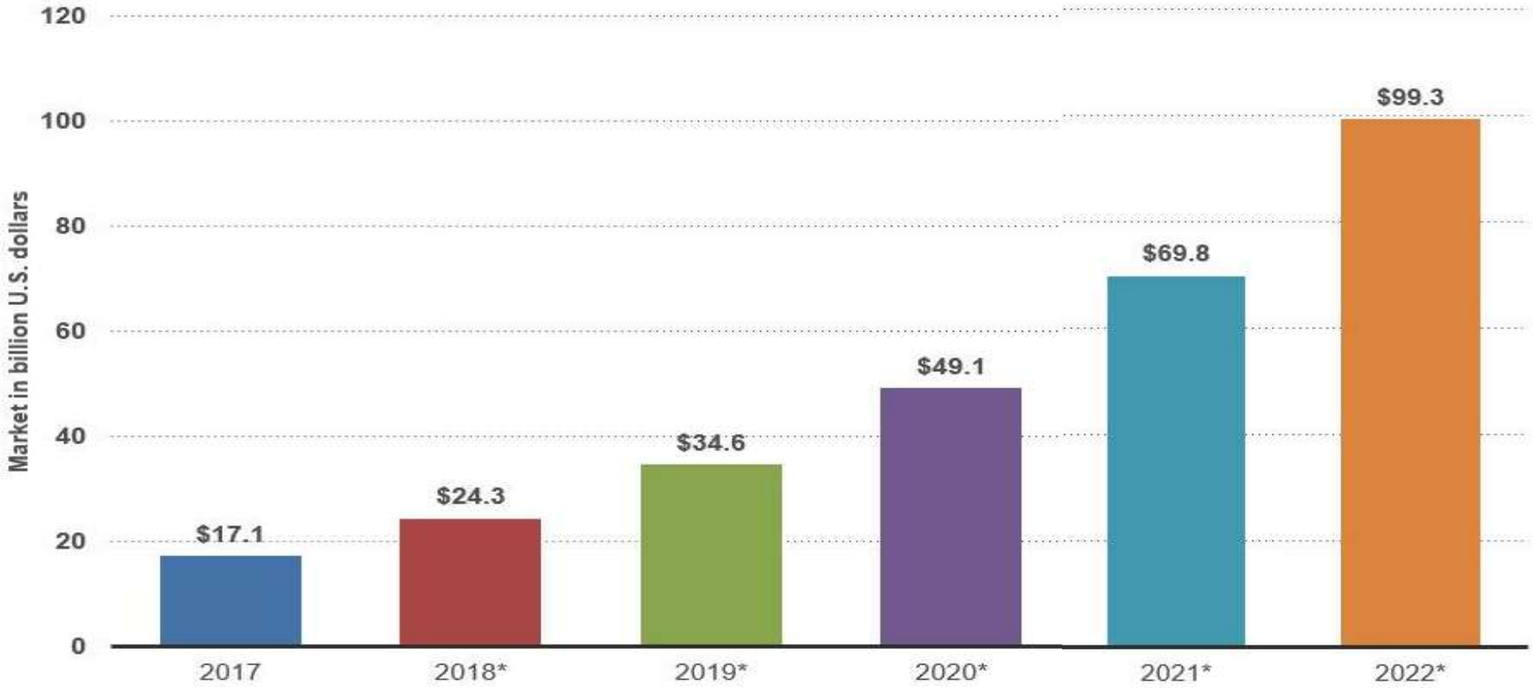
Introduction to Digital Data

NAME	SYMBOL	VALUE	EQUAL VALUE
byte	b	8 bits	1 byte
kilobyte	Kb	1024 bytes	1 024 bytes
megabyte	MB	1024 KB	1 048 576 bytes
gigabyte	GB	1024 MB	1 073 741 824 bytes
terabyte	TB	1024 GB	1 099 511 627 776 bytes
Petabyte	PB	1024 TB	1 125 899 906 842 624 bytes
Exabyte	EB	1024 PB	1 152 921 504 606 846 976 bytes
Zetabyte	ZB	1024 EB	1 180 591 620 717 411 303 424 bytes
Yottabyte	YB	1024 ZB	1 208 925 819 614 629 174 706 176 bytes
Brontobyte	BB	1024 YB	1 237 940 039 285 380 274 899 124 224 bytes
Geopbyte	GB	1024 BB	1 267 650 600 228 229 401 496 703 205 376 bytes

CLASSIFICATION OF DIGITAL DATA

Introduction to Digital Data (contd..)

Size of Big Data Market Worldwide in U.S. Billion Dollars (2017 to 2022)

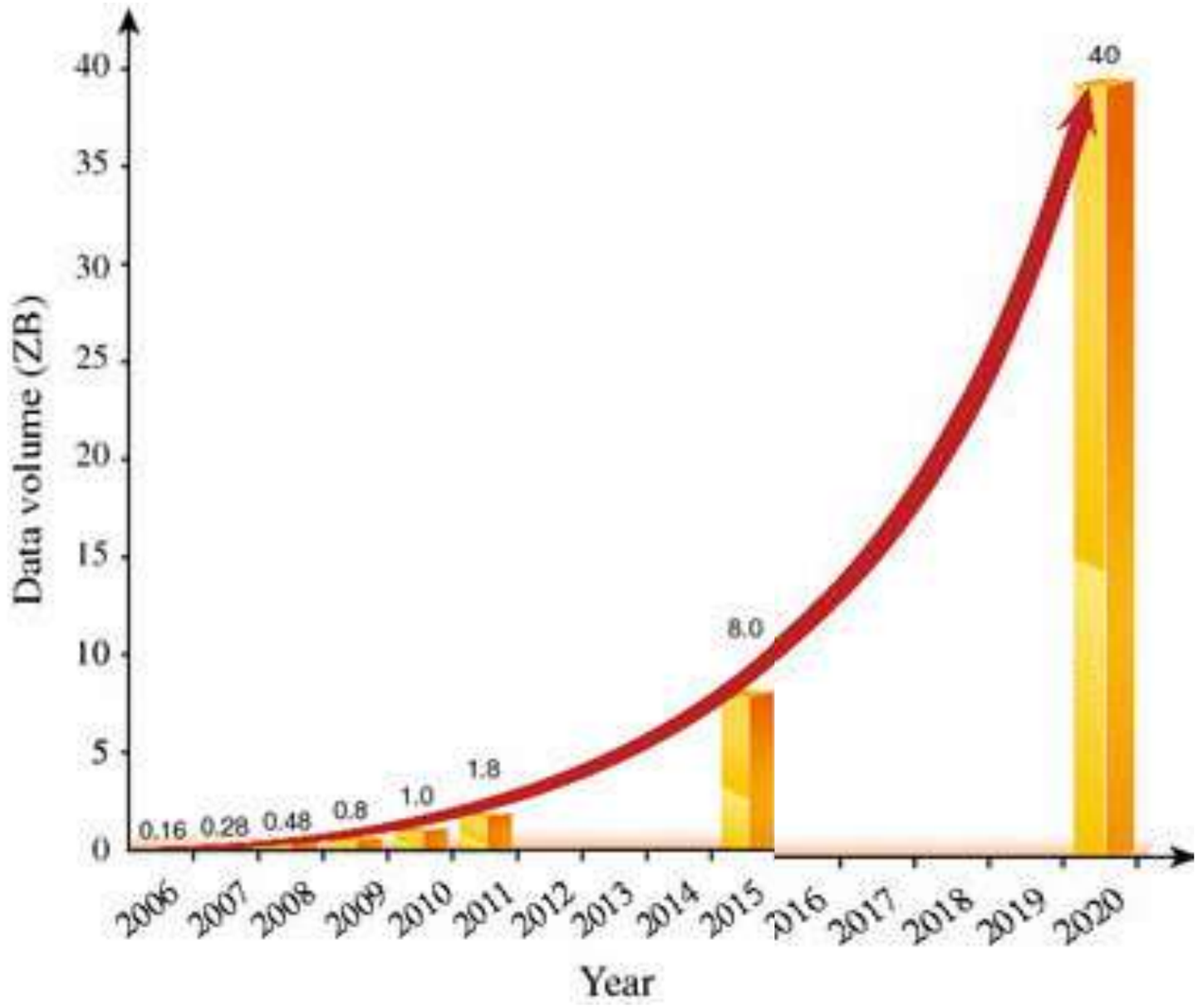


Worldwide Big Data market revenues for software and services are projected to increase from attaining a Compound Annual Growth Rate (CAGR) of 10.48%.

Source: Wikibon and reported by Statista.

CLASSIFICATION OF DIGITAL DATA

Introduction to Digital Data (contd..)



Data growth --- exponential acceleration --- advent of the computer and internet

Defined as the data stored in digital format

Ex. A picture, a document or a video etc.

Not physical --- but stored in digital form

CLASSIFICATION OF DIGITAL DATA

Introduction to Digital Data (contd..)

Structured data

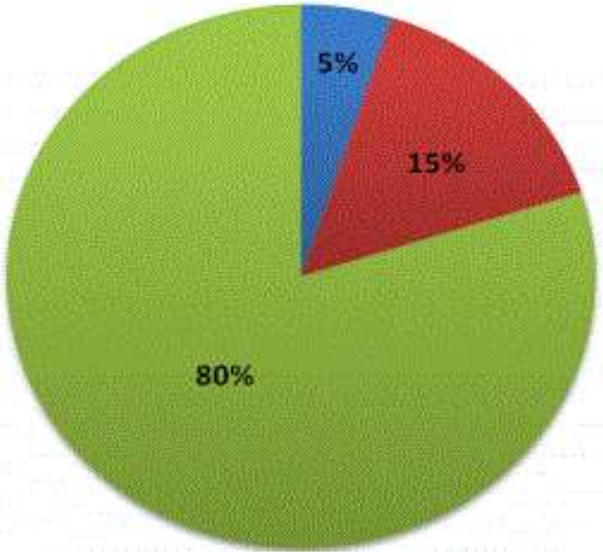
ID	Name	Age	Degree
1	John	18	B.Sc.
2	David	31	Ph.D.
3	Robert	51	Ph.D.
4	Rick	26	M.Sc.
5	Michael	19	B.Sc.

Semi-structured data

```
<University>
  <Student ID="1">
    <Name>John</Name>
    <Age>18</Age>
    <Degree>B.Sc.</Degree>
  </Student>
  <Student ID="2">
    <Name>David</Name>
    <Age>31</Age>
    <Degree>Ph.D. </Degree>
  </Student>
....
</University>
```

Unstructured data

The university has 5600 students.
John's ID is number 1, he is 18 years old and already holds a B.Sc. degree.
David's ID is number 2, he is 31 years old and holds a Ph.D. degree. Robert's ID is number 3, he is 51 years old and also holds the same degree as David, a Ph.D. degree.



Structured
Semi-Structured
Un-Structured

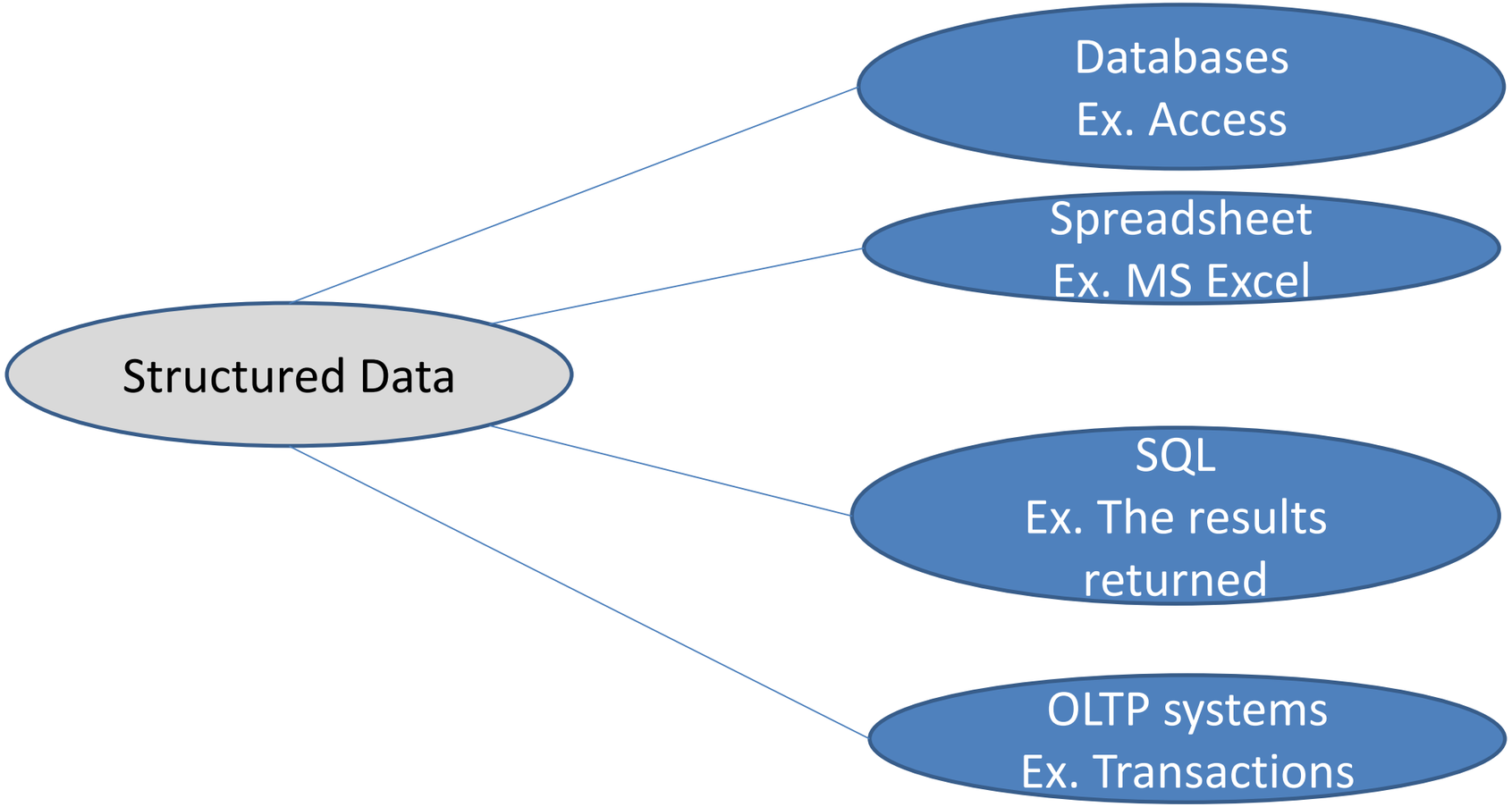
Classification of digital data

Structured Data

CLASSIFICATION OF DIGITAL DATA

Structured Data

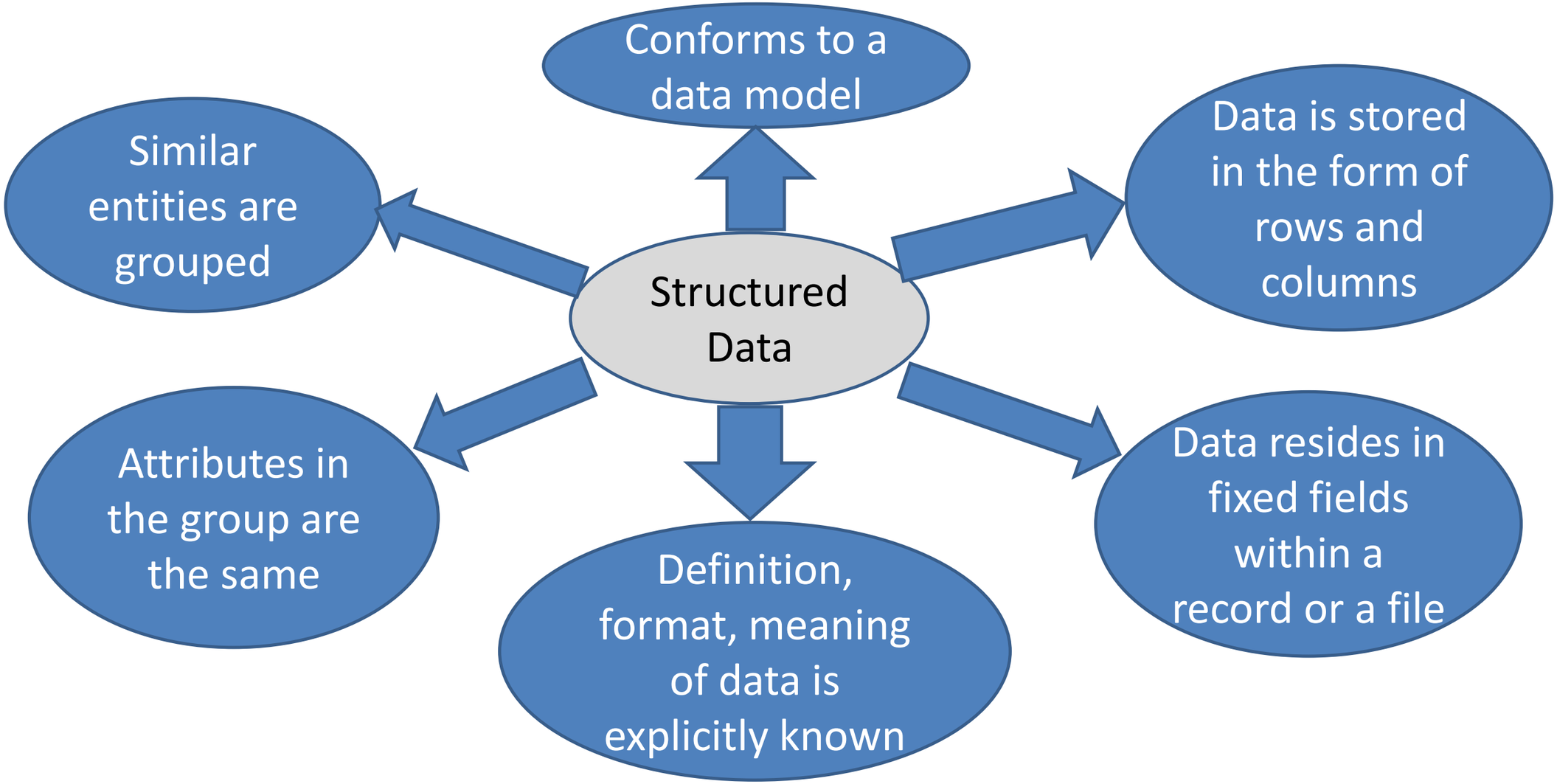
The sources of Structured Data:



CLASSIFICATION OF DIGITAL DATA

Structured Data (contd..)

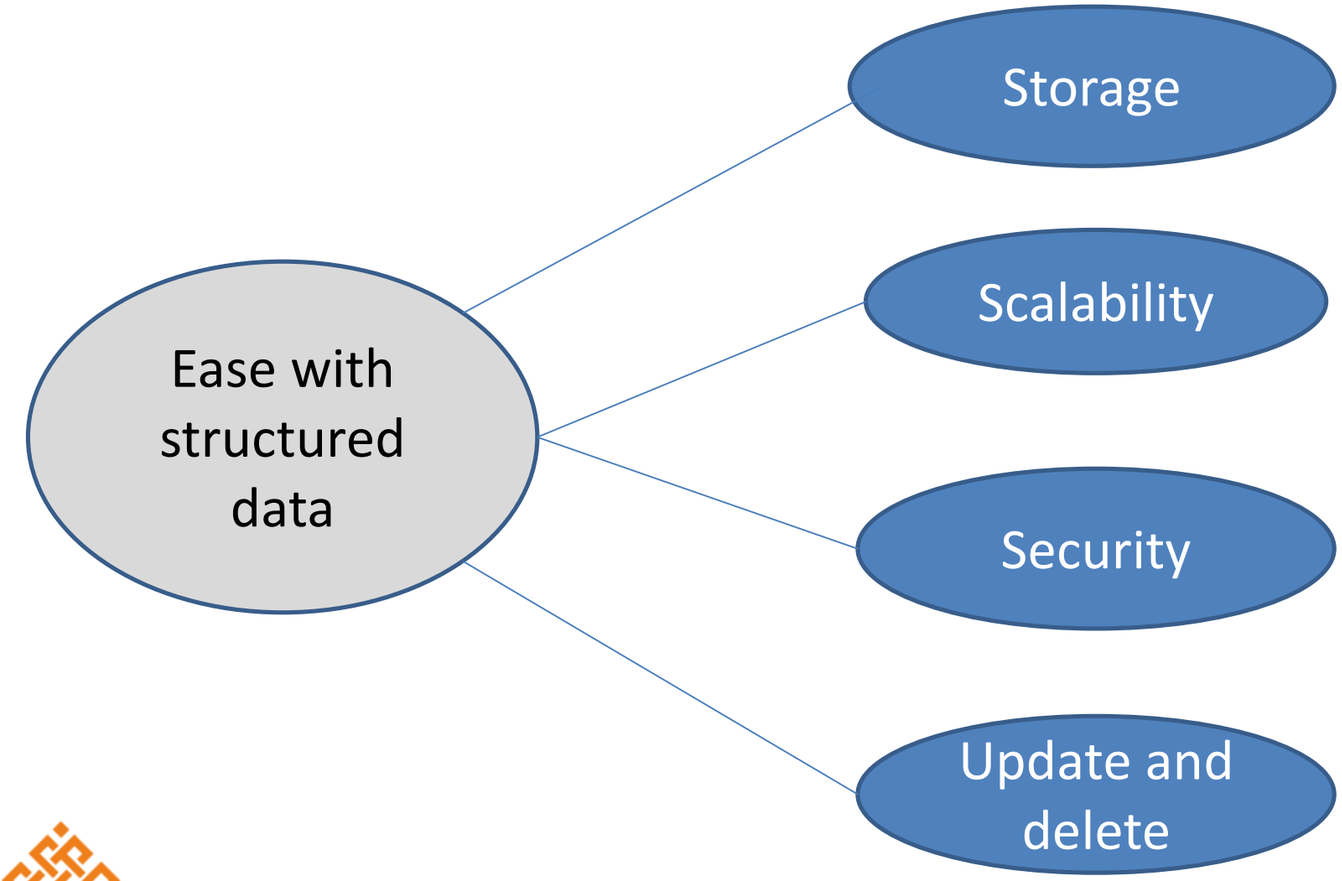
The characteristics of Structured Data:



CLASSIFICATION OF DIGITAL DATA

Structured Data (contd..)

The ease of dealing with Structured Data:



- Retrieval of structured data is totally hassle free.
- **Indexing and searching**
- **Mining Data**
- **BI operations**

CLASSIFICATION OF DIGITAL DATA

Structured Data (contd..)

The summary of Structured Data:

- Consists of fully described data sets.
- Has clearly defined categories and sub-categories.
- Is placed neatly in rows and columns.
- Goes into records and hence the database is regulated by a well-defined structure.
- Can be indexed easily by the Database System itself or manually.

Classification of digital data

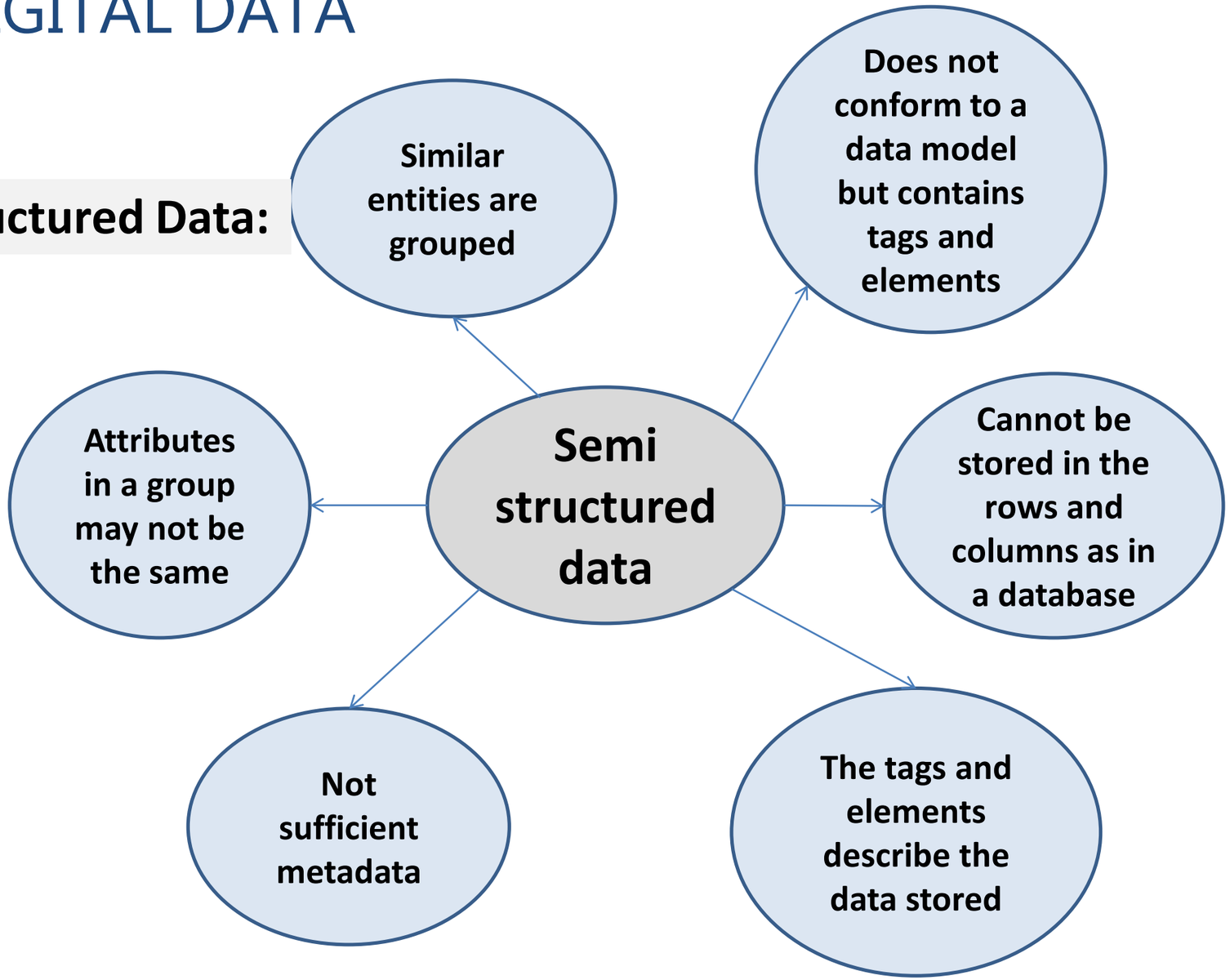
Semi-structured Data

CLASSIFICATION OF DIGITAL DATA

Semi-Structured Data

The characteristics of Semi-Structured Data:

- Only about 10% of data in any organization is semi-structured
- Comes from heterogeneous sources.



CLASSIFICATION OF DIGITAL DATA

Semi-Structured Data (contd..)

Email Standard format:

To : <NAME>

From : <NAME>

Subject : <TEXT>

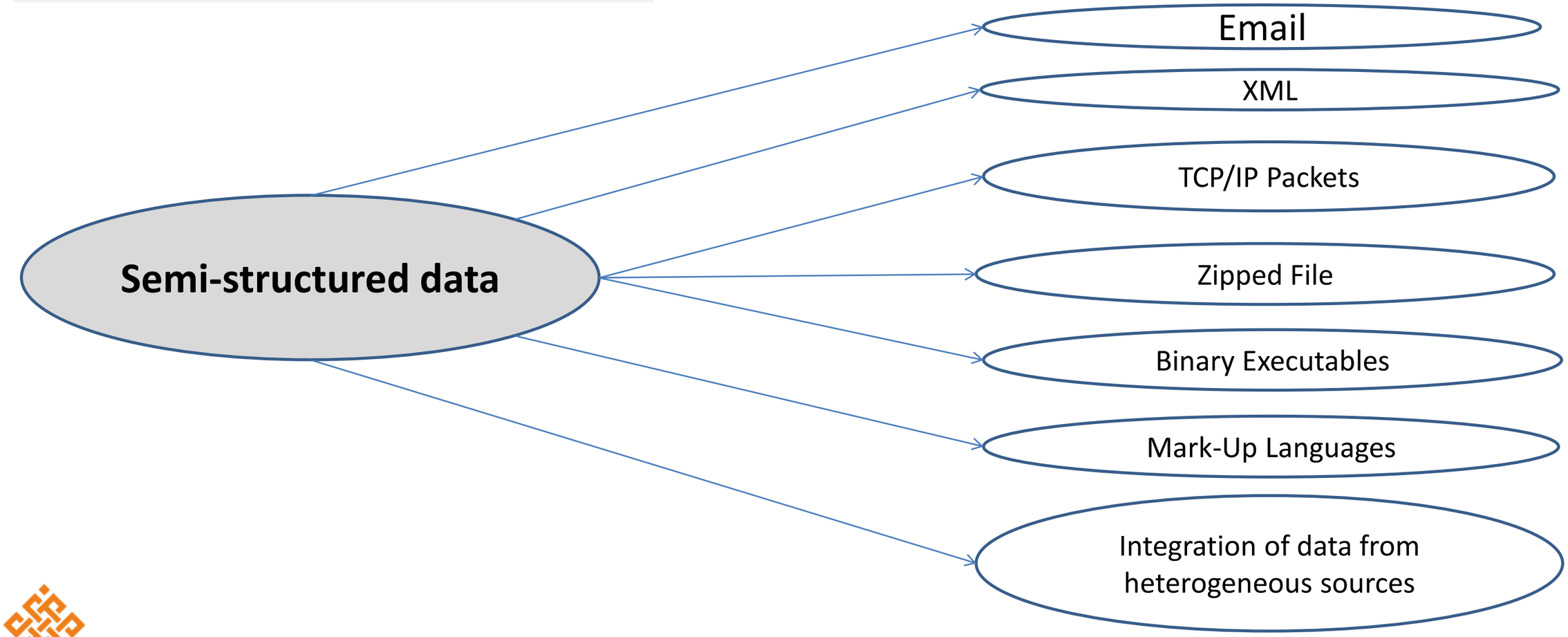
CC : <NAME>

Body : <TEXT,GRAPHICS,IMAGES,ETC>

CLASSIFICATION OF DIGITAL DATA

Semi-Structured Data (contd..)

Sources of Semi-structured Data:



CLASSIFICATION OF DIGITAL DATA

Unstructured Data

- Cannot be stored in the form of rows and columns
- Does not conform to any data model
- Difficult to determine the meaning of the data
- Does not follow any rules
- Can be of any type
- Unpredictable

CLASSIFICATION OF DIGITAL DATA

Unstructured Data (contd..)

Major sources of Unstructured data:

- Anything in a non-database form
- It can be divided into two broad categories:
  - **Bitmap objects**: For e.g. Image, video or audio files.
  - **Textual objects**: For e.g. Microsoft word documents, emails or MS Excel.
- A noisy text such as chats, emails and SMS texts.

CLASSIFICATION OF DIGITAL DATA

Unstructured Data (contd..)

Major sources of Unstructured data:

- Web pages,
- Memos,
- Videos (MPEG, etc.),
- Images (JPEG, GIF, etc.),
- body of an email,
- Word document,
- PowerPoint presentation,
- Chats, Reports,
- White papers,
- Surveys etc.

CLASSIFICATION OF DIGITAL DATA

Unstructured Data (contd..)

Issues in the terminology of Unstructured data:

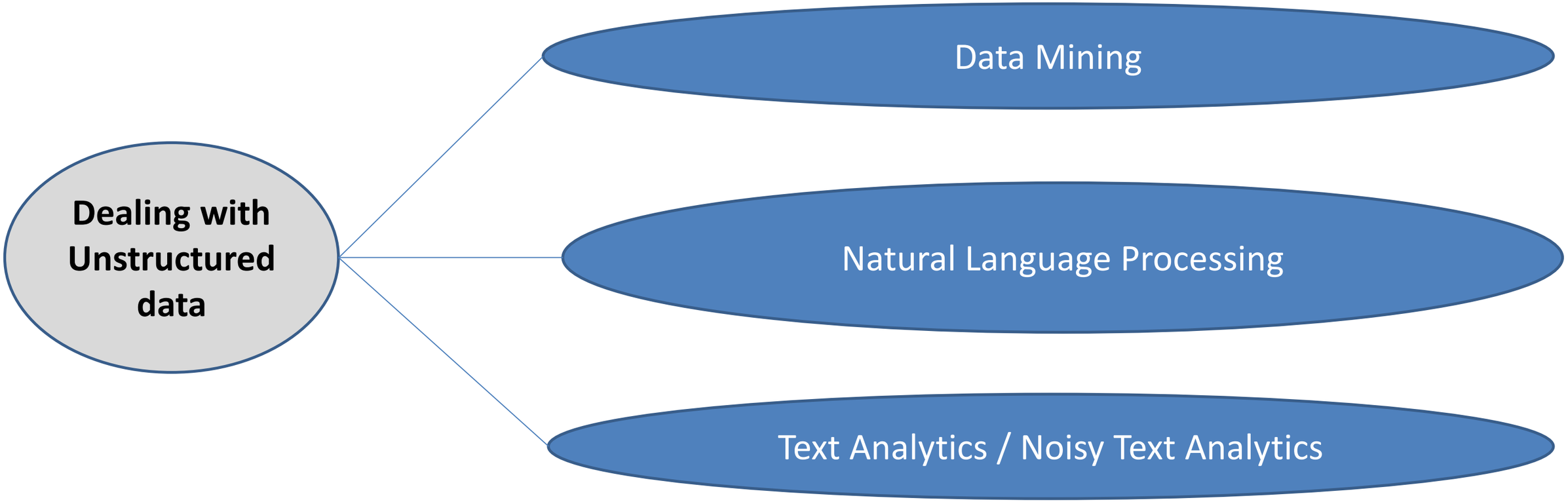
Issues in the terminology

- Structure can be implied despite not being formerly defined
- Data with some structure may still be labeled unstructured
- Data may have some structure or some high structure

CLASSIFICATION OF DIGITAL DATA

Unstructured Data (contd..)

Dealing with Unstructured data:

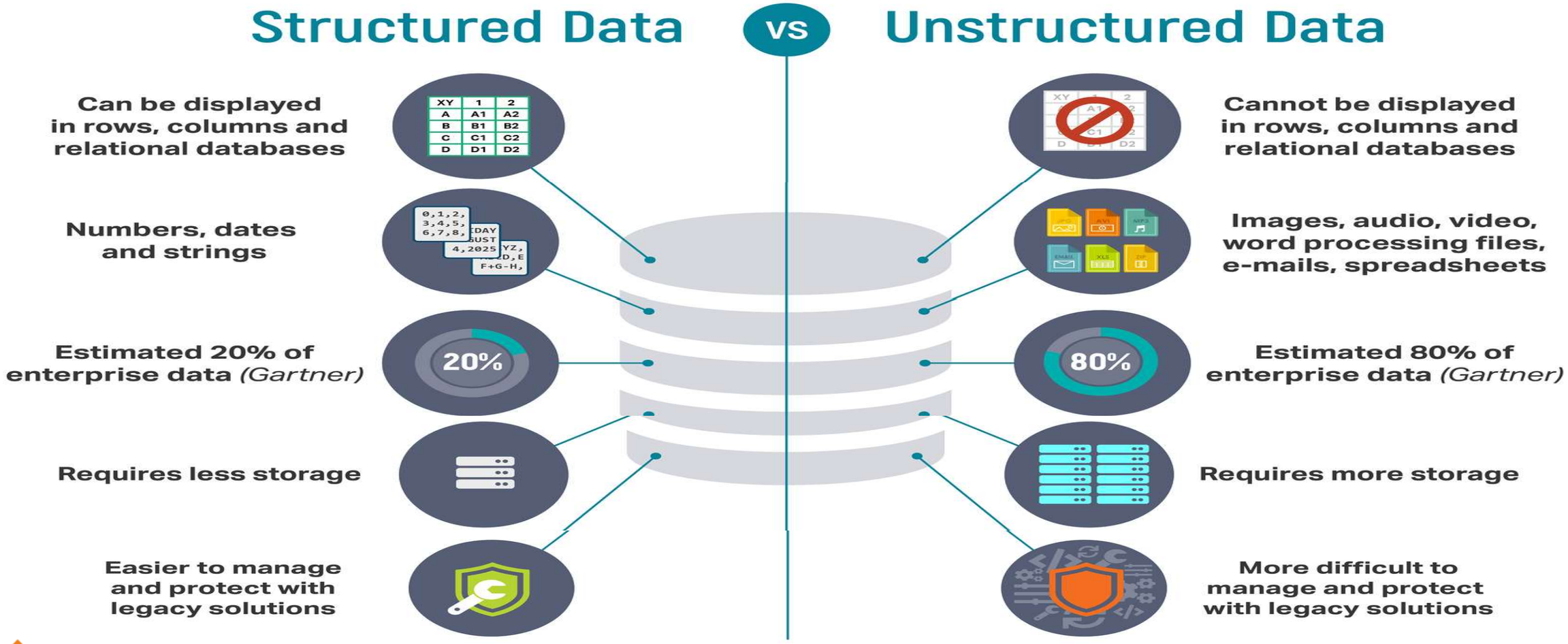


Classification of digital data

Structured Data Vs. Unstructured Data

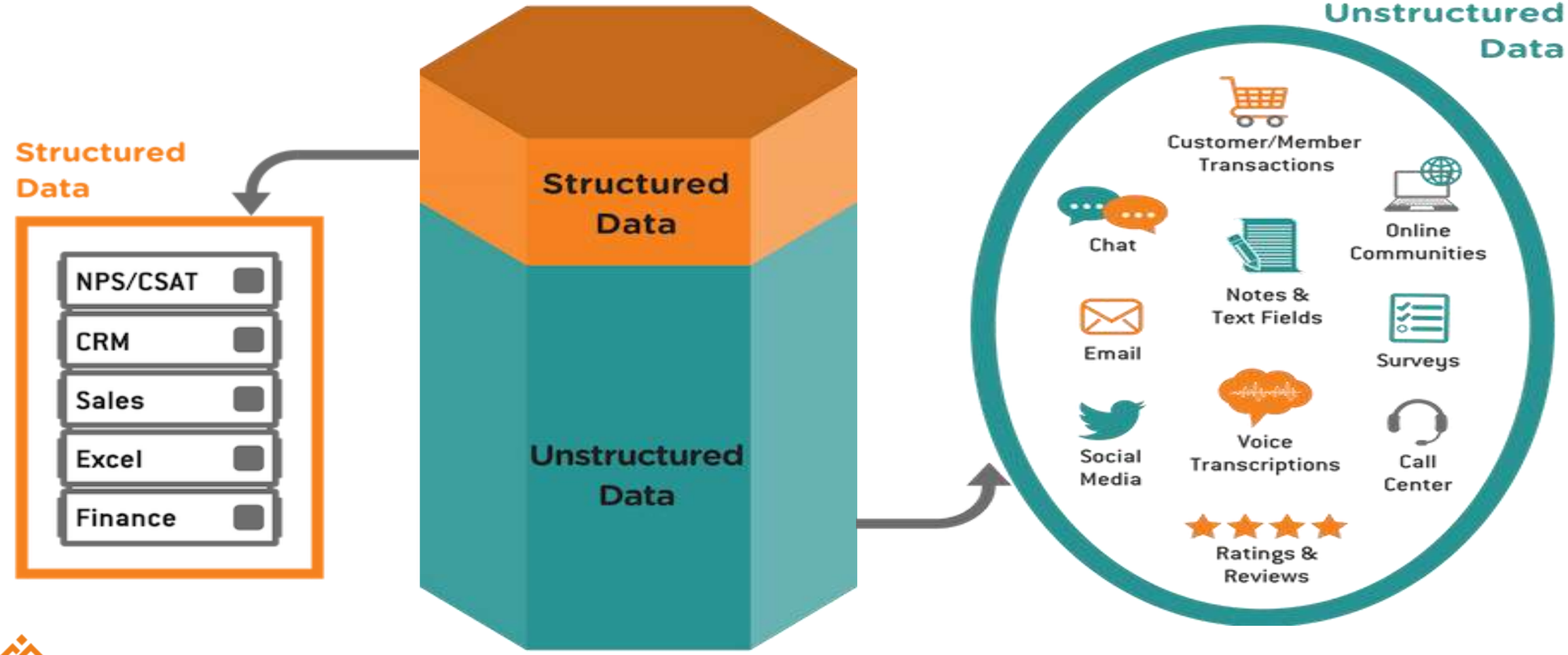
CLASSIFICATION OF DIGITAL DATA

Structured Data Vs. Unstructured Data



CLASSIFICATION OF DIGITAL DATA

Structured Data Vs. Unstructured Data (contd..)



CLASSIFICATION OF DIGITAL DATA

Structured Data Vs. Unstructured Data (contd..)

Structured data	Semi-structured data	Unstructured data
Databases	XML / JSON data Email Web pages	Audio Video Image data Natural language Documents

CLASSIFICATION OF DIGITAL DATA

Structured Data Vs. Unstructured Data (contd..)

	Structured Data	Unstructured Data
Characteristics	• Pre-defined data models • Usually text only • Easy to search	• No pre-defined data model • May be text, images, sound, video or other formats • Difficult to search
Resides in	• Relational databases • Data warehouses	• Applications • NoSQL databases • Data warehouses • Data lakes
Generated by	Humans or machines	Humans or machines
Typical applications	• Airline reservation systems • Inventory control • CRM systems • ERP systems	• Word processing • Presentation software • Email clients • Tools for viewing or editing media
Examples	• Dates • Phone numbers • Social security numbers • Credit card numbers • Customer names • Addresses	• Text files • Reports • Email messages • Audio files • Video files • Images

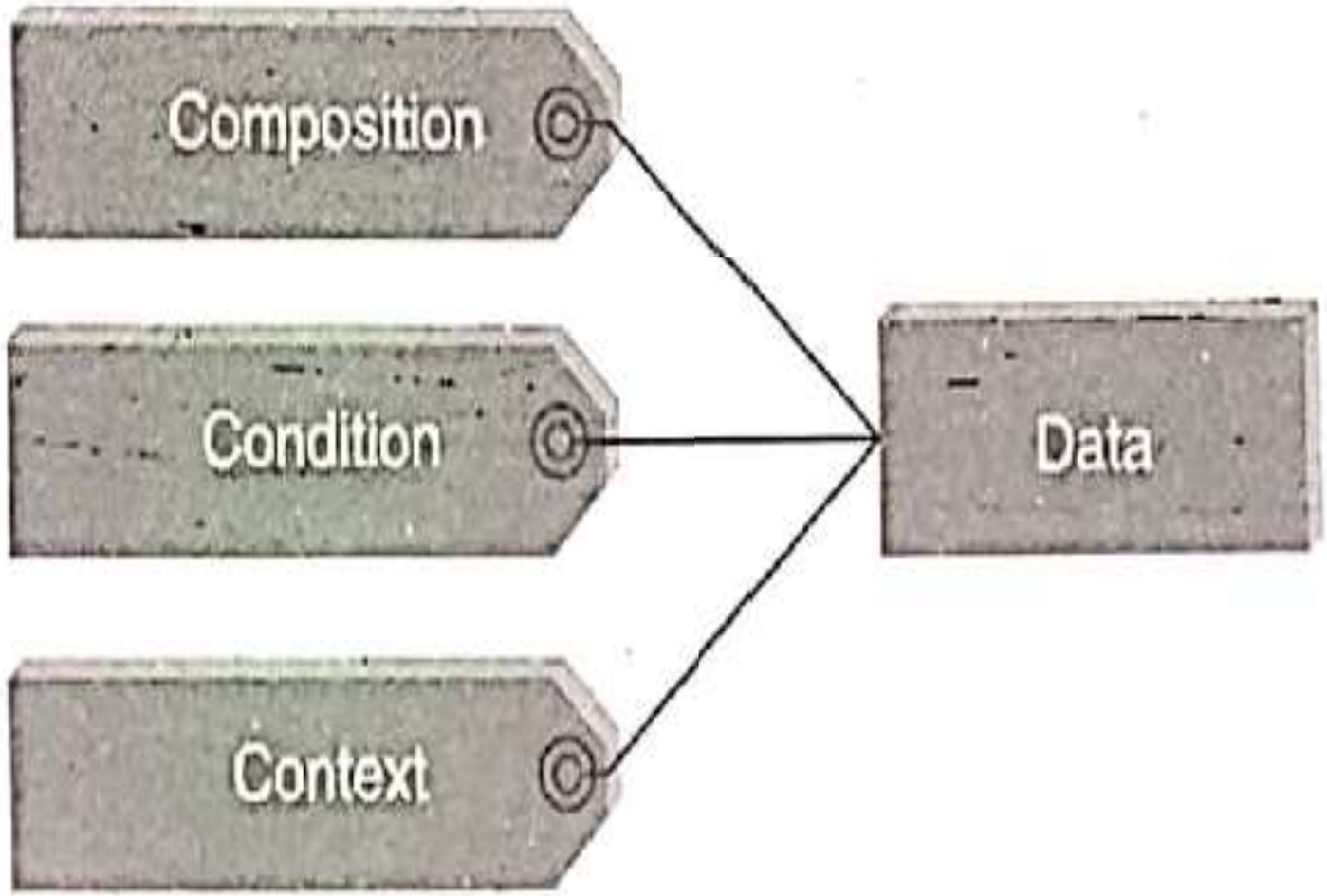
CLASSIFICATION OF DIGITAL DATA

Structured Data Vs. Unstructured Data (contd..)

	Data Types	Source	Examples in e-Businesses
Structured	Transaction or business activity data	Retail transactions, customer profiles, product consumption, customer complaints	Amazon revealed at one point that 30%of sales were generated through its recommendation engine.
Unstructured	Click-stream data	social media content, online advertisements	eBay conducts thousands of experiments with different aspects of its website to determine optimal layout.
Unstructured	Video data	Video data from retail and other settings	Netflix uses video data to predict viewing habits and evaluate the quality of customers experiences.
Unstructured	Voice data	Voice data from phone calls, call centers, customer service	Credit card companies can make personalized offers in milliseconds and to optimize offers by tracking responses.

CLASSIFICATION OF DIGITAL DATA

Characteristics of Data



CLASSIFICATION OF DIGITAL DATA

Characteristics of Data (contd..)

- **Composition**:
  - structure, source, granularity, nature of data - check if the data is static or real-time processing
- **Condition**:
  - State of the data - is the data clean or needs cleaning?
- **Context**:
  - Data source, associated events – understand the data

SUMMARY OF THE LECTURE

- Introduction to digital data
- Structured data
- Semi-structured data
- Unstructured data
- Characteristics of data

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Lecture 1.4
Evolution of Big Data

Evolution of Big Data

Topic of the Lecture

EVOLUTION OF BIG DATA

Introduction

EVOLUTION OF BIG DATA

Introduction (contd..)

Big data --- an enigma to many people.
new term --- coined during the latter part of the last decade.

Ambiguous to many people--- since it’s inception

Not just **enormous amounts of data** --- whole process of gathering, storing and analyzing that data.

EVOLUTION OF BIG DATA

Introduction (contd..)

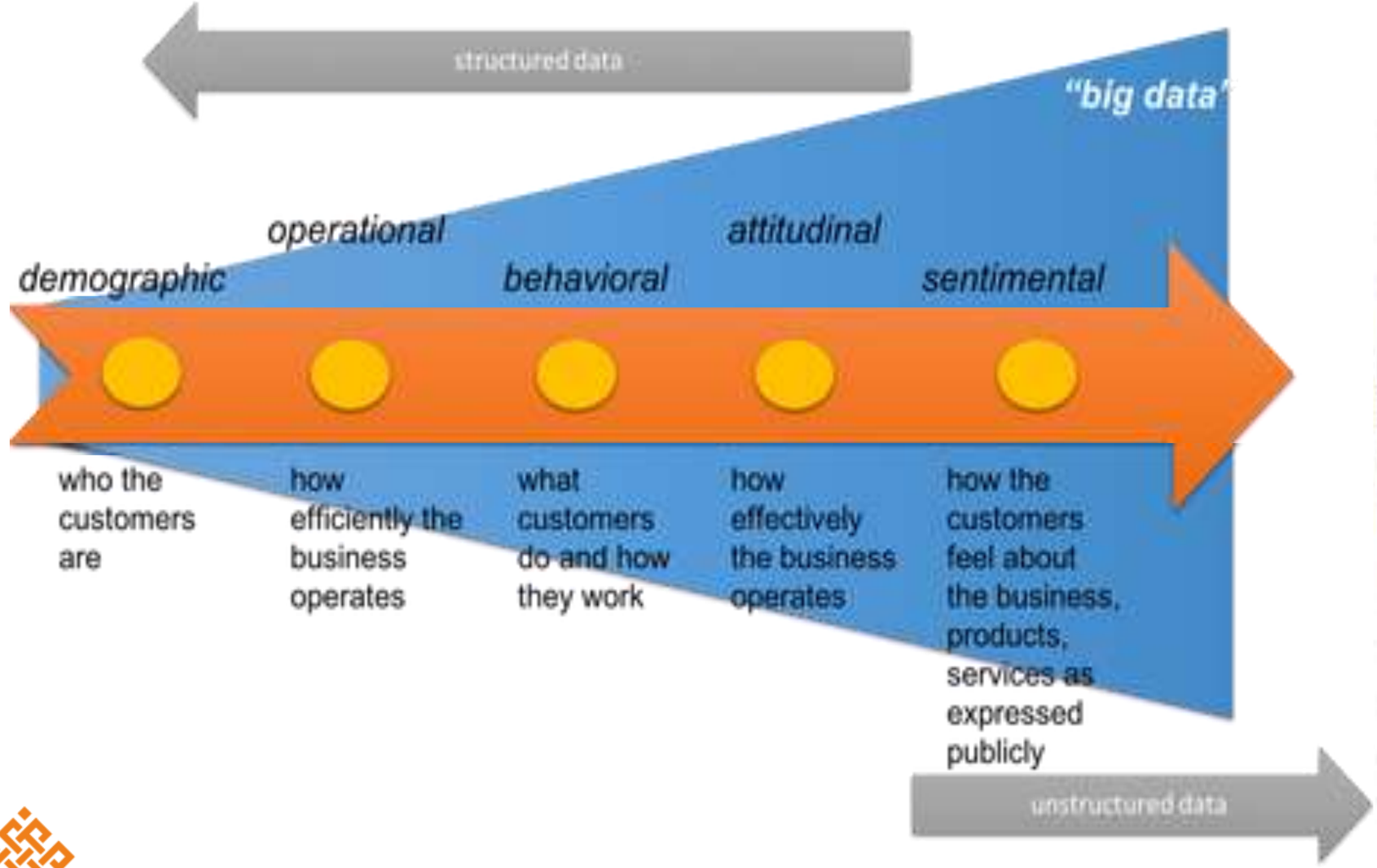
Big data --- big business tool --- past
Ambiguous to many people--- since it's inception

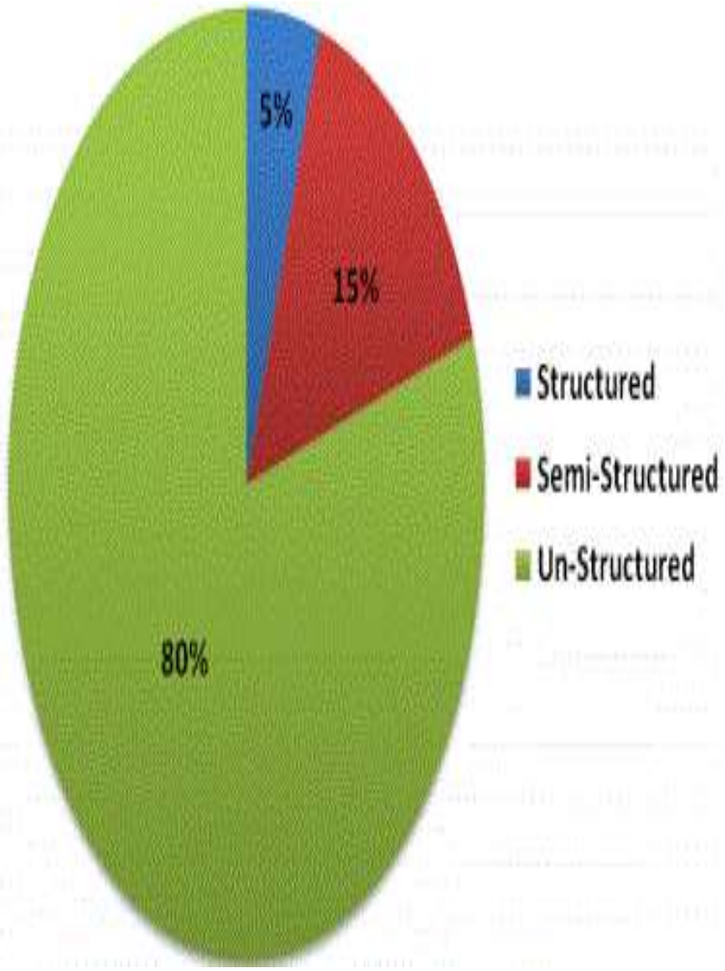
Increasingly clear about what and why big data is important --- to so many different companies.

In 1998, **John Mashey**, who was Chief Scientist at SGI presented a paper titled "Big Data… and the Next Wave of Infrastress." at a USENIX meeting.

EVOLUTION OF BIG DATA

Introduction (contd..)



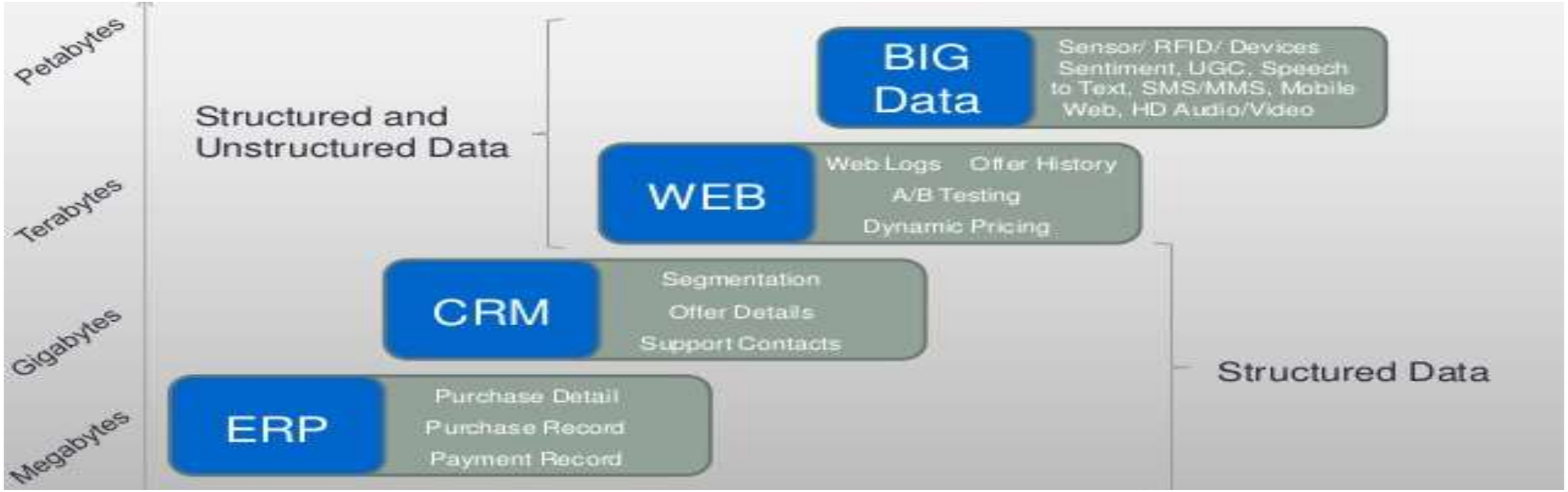


EVOLUTION OF BIG DATA

Introduction (contd..)

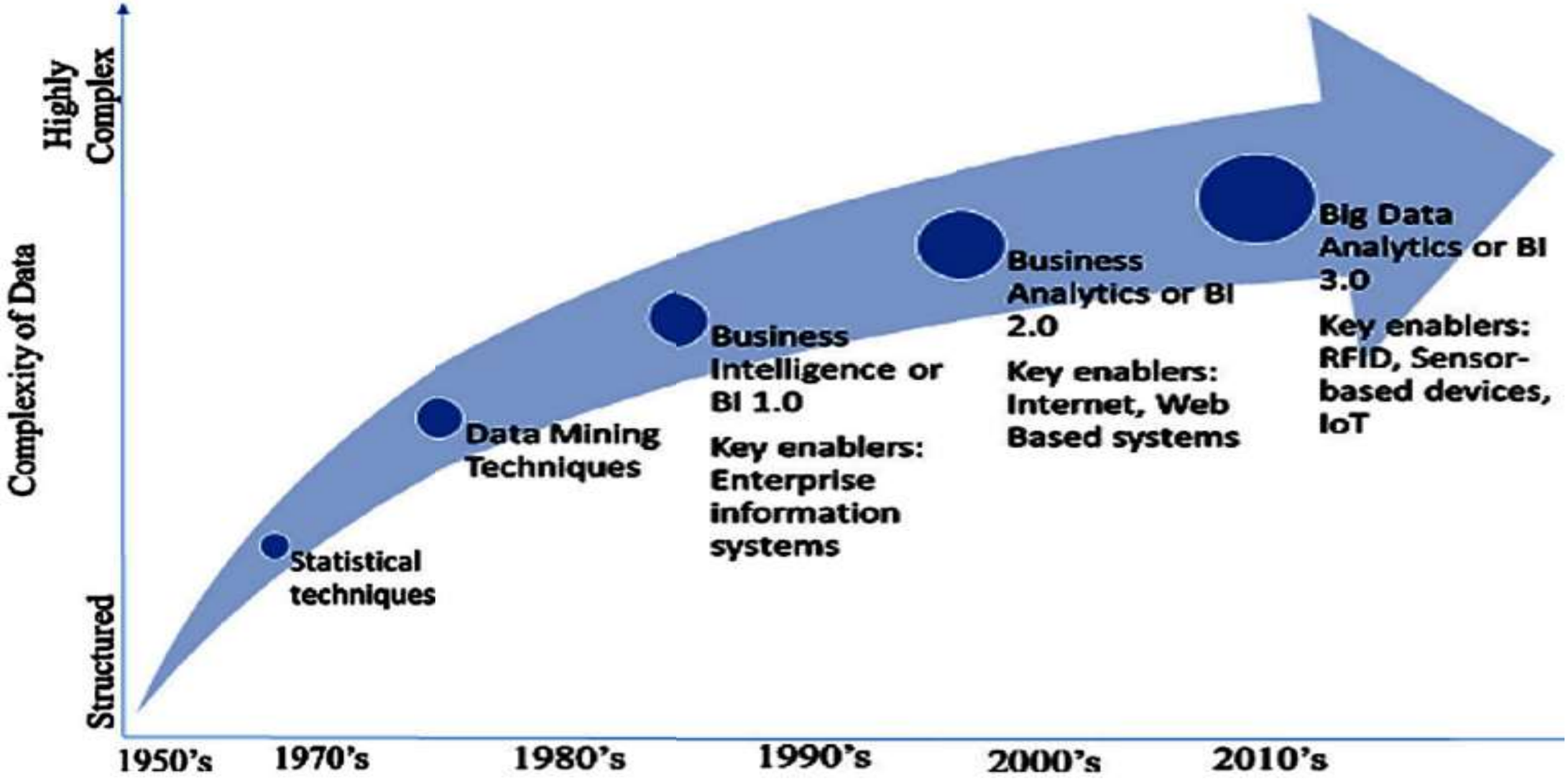
Data Evolution .....

10% are structured and 90% are unstructured like emails, videos, facebook posts, website clicks etc.



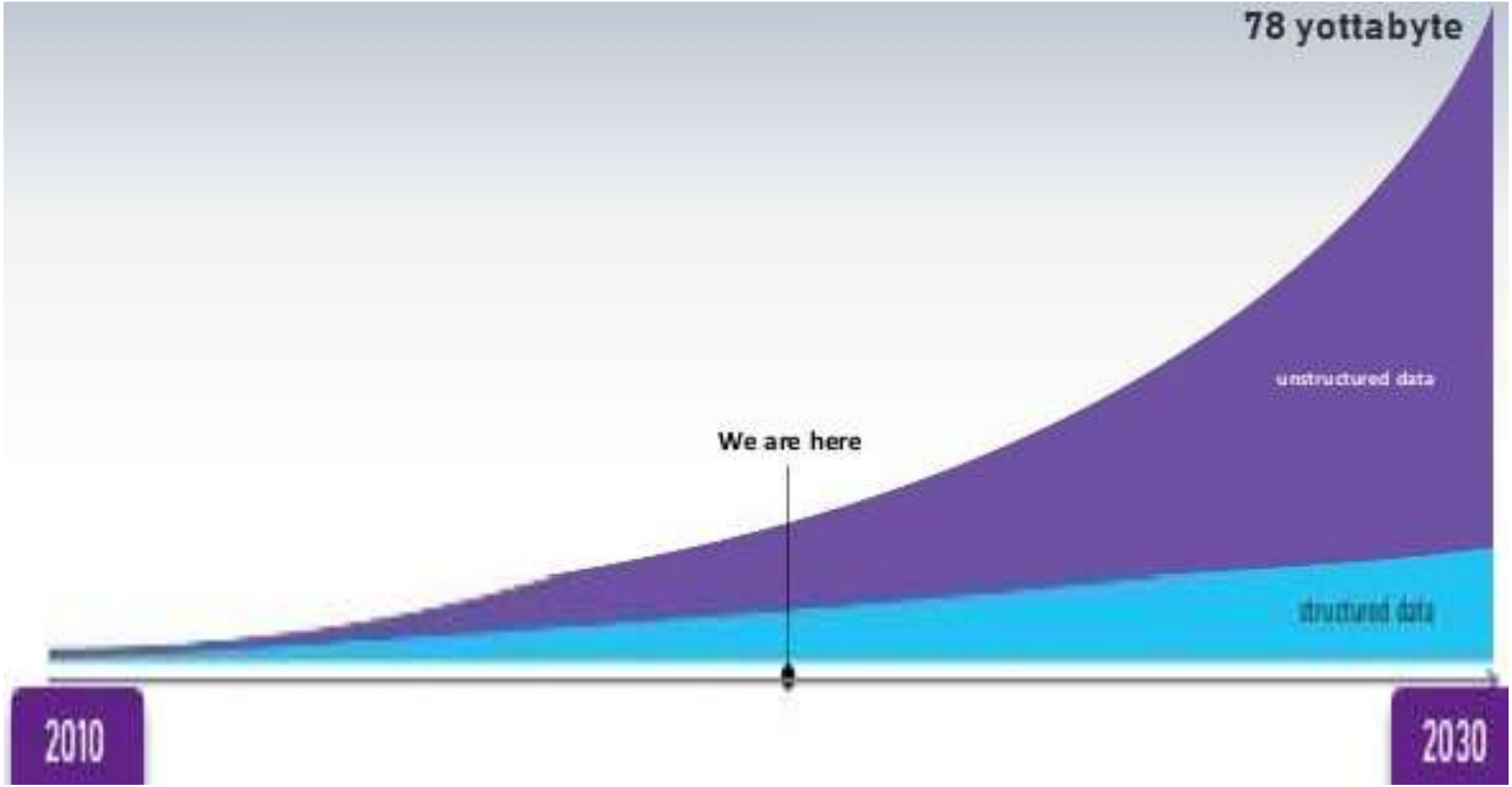
EVOLUTION OF BIG DATA

Introduction (contd..)



EVOLUTION OF BIG DATA

Introduction (contd..)



Evolution of Big Data

Big Data Use Cases

EVOLUTION OF BIG DATA

Big Data Use Cases

Banking Sector:

EVOLUTION OF BIG DATA

Big Data Use Cases (contd..)

Health Care Sector:

EVOLUTION OF BIG DATA

Big Data Use Cases (contd..)

Retail Sector:

EVOLUTION OF BIG DATA

Technologies

APACHE hadoop

Apache Flink

tableau

APACHE Spark™

HIVE

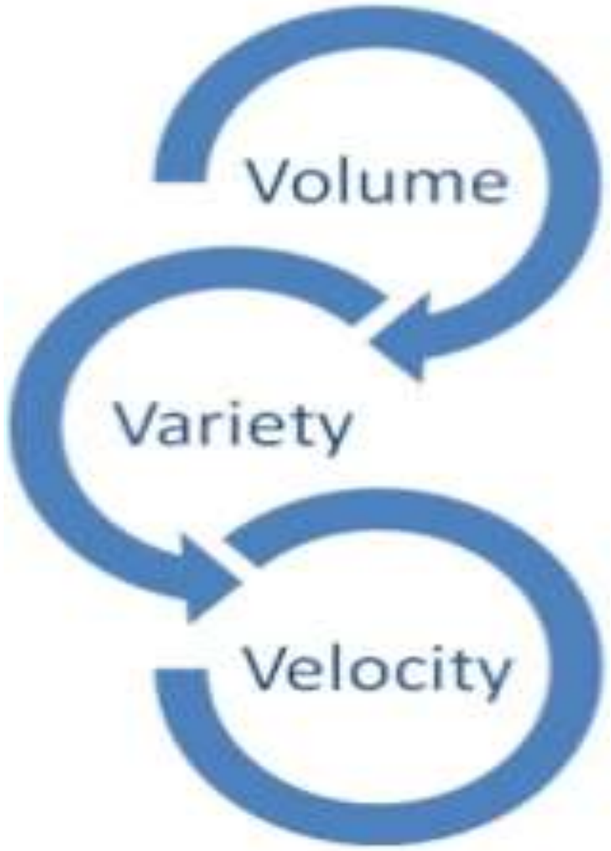
QlikView

Evolution of Big Data

Definition of Big Data

EVOLUTION OF BIG DATA

Definition of Big Data



2001: Doug Laney first uses "Volume, Velocity & Variety" to describe Big Data[2]

2012: Gartner updates the definition to:

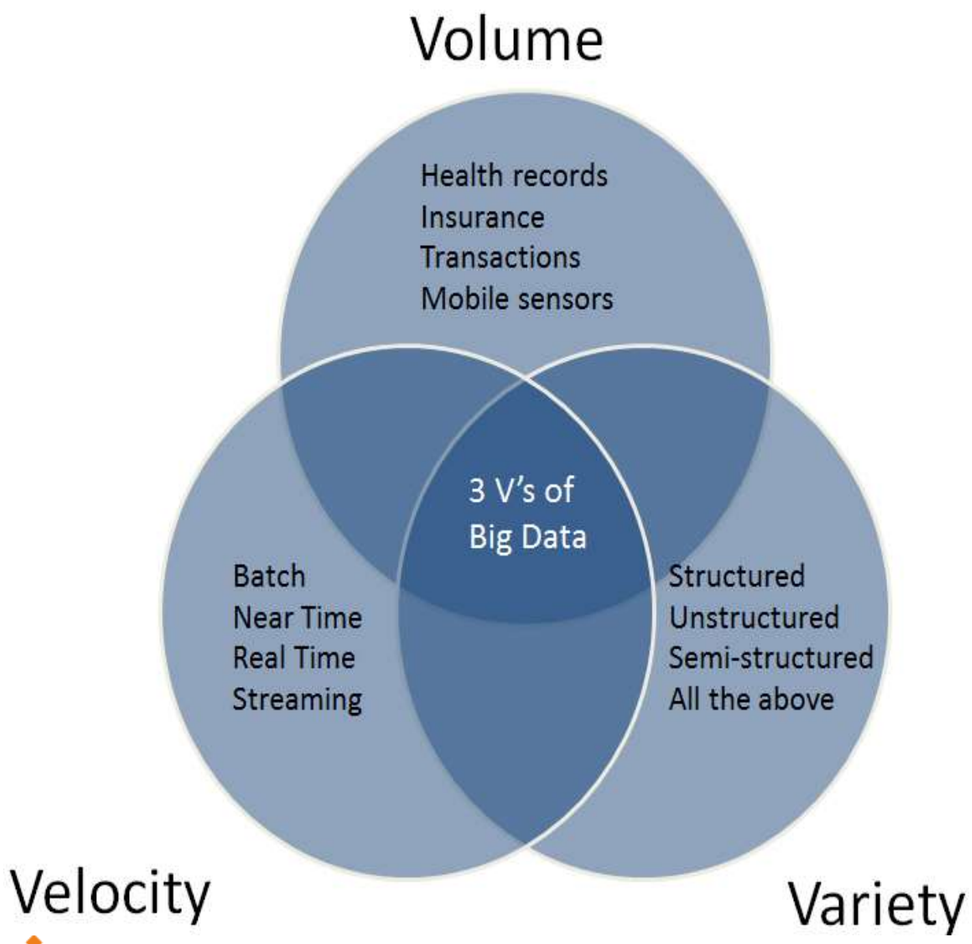
"Big data are high volume, high velocity and/or high variety information assets that require new forms of processing to enable enhanced decision making, insight discovery and process automation"

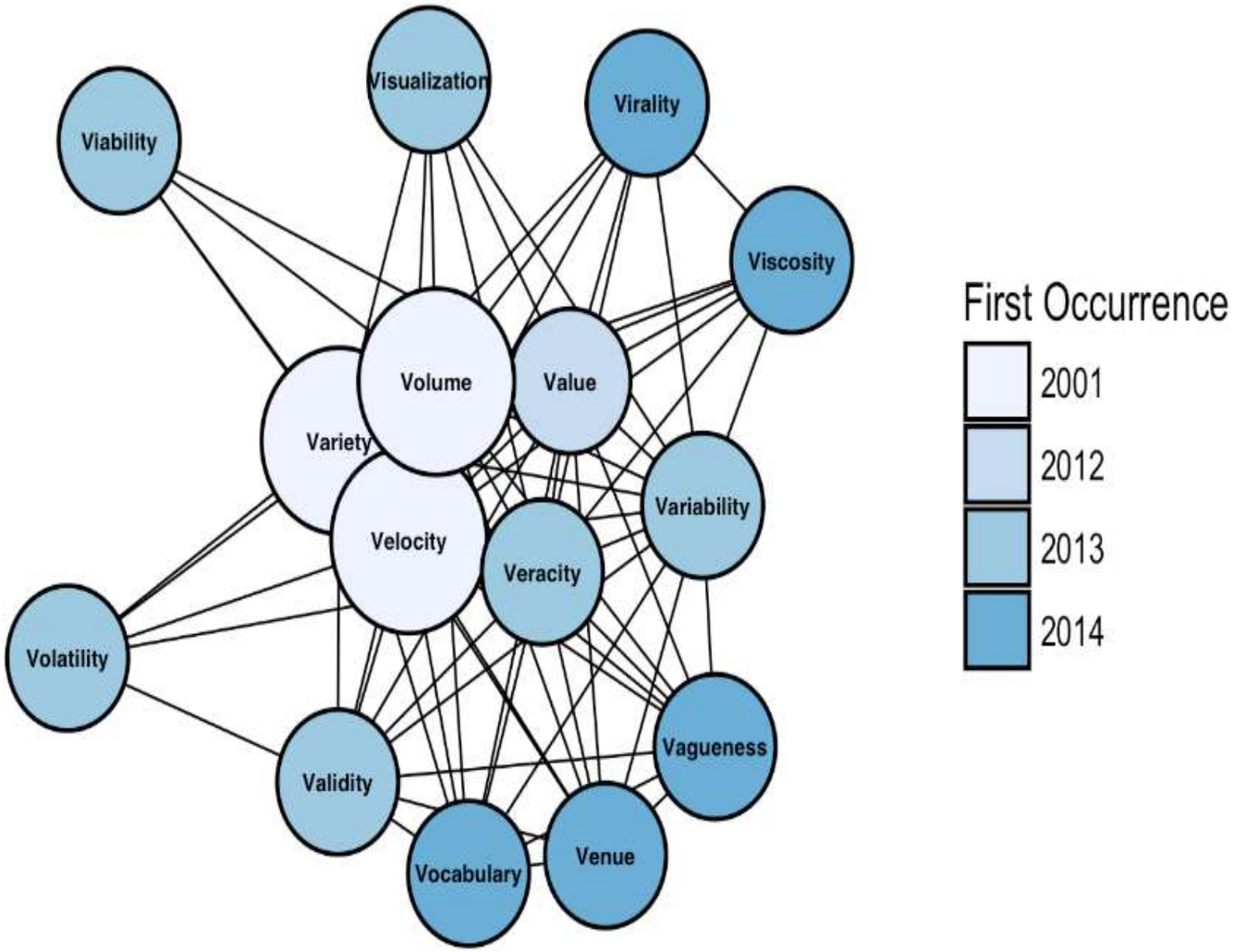
Evolution of Big Data

V’s of Big Data

EVOLUTION OF BIG DATA

V's of Big Data





SUMMARY OF THE LECTURE

- Introduction to Evolution of Big Data
- Big Data Use Cases
- Technologies used for Big Data
- Definition of Big Data

Evolution of Big Data

Resources and Tasks to be completed

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Lecture 1.5
Challenges with Big Data

School of Computer Science and Engineering

Challenges with Big Data

Recap of previous Lecture

Challenges with Big Data

Topic of the Lecture

Challenges with Big Data

Objective and Outcome of Lecture

Challenges with Big Data

Introduction

CHALLENGES WITH BIG DATA

Introduction

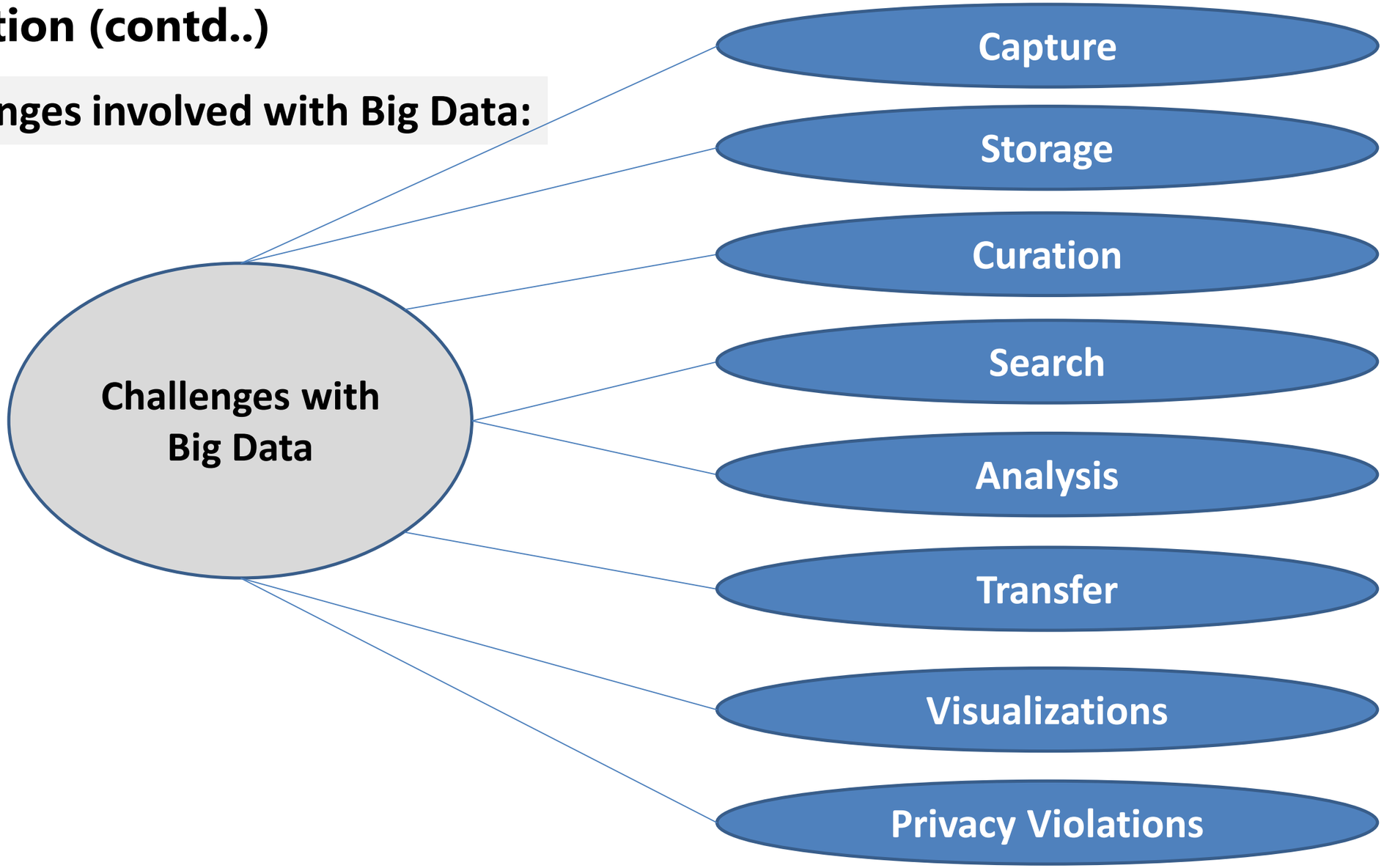
The challenges involved with Big Data:

1) Picking the Right NoSQL Tools
2) Scaling up and down Big Data according to Current Demand
3) Overcoming Big Data Talent and Resource Constraints
4) Collecting and Integrating Massive and Diverse Datasets
5) Maintaining Data Integrity, Security, and Privacy

CHALLENGES WITH BIG DATA

Introduction (contd..)

The challenges involved with Big Data:



CHALLENGES WITH BIG DATA

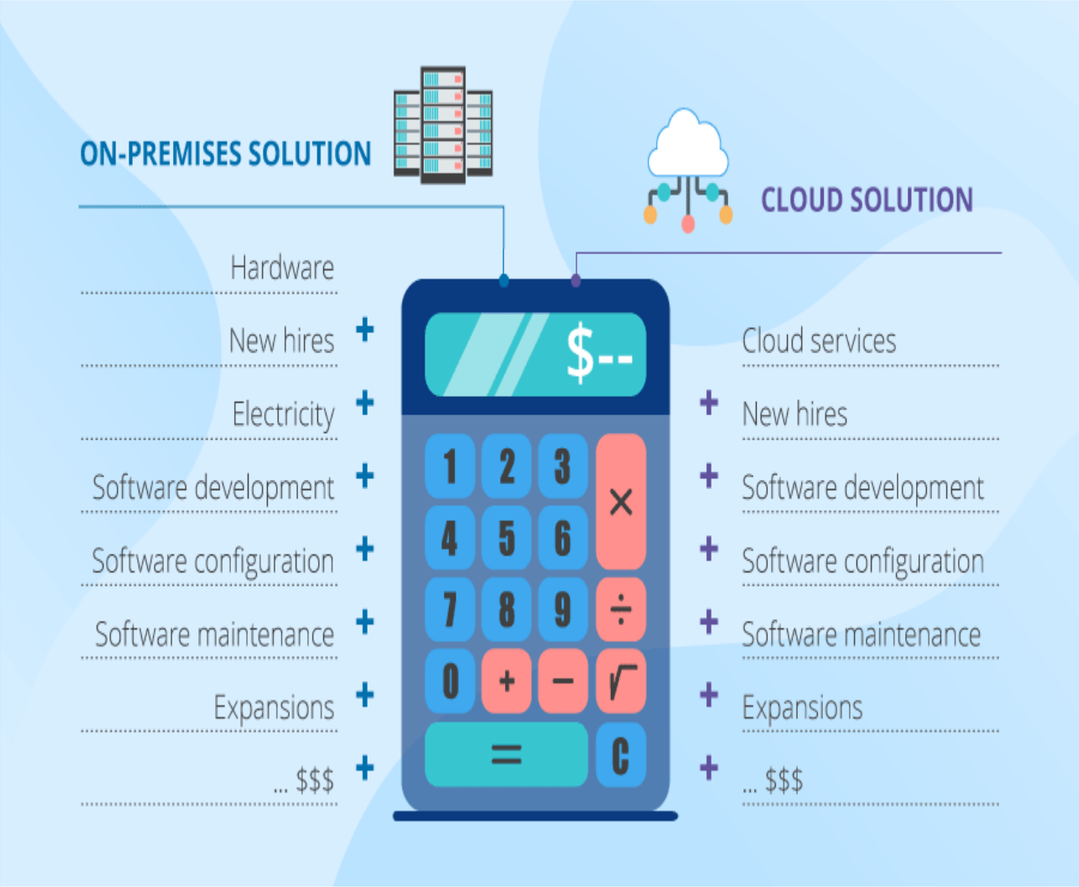
Introduction (contd..) Summary

- Insufficient understanding and acceptance of big data
- Confusing variety of big data technologies
- Paying loads of money
- Complexity of managing data quality
- Dangerous big data security holes
- Tricky process of converting big data into valuable insights
- Troubles of upscaling

CHALLENGES WITH BIG DATA

Introduction (contd..)

- **Paying loads of money**

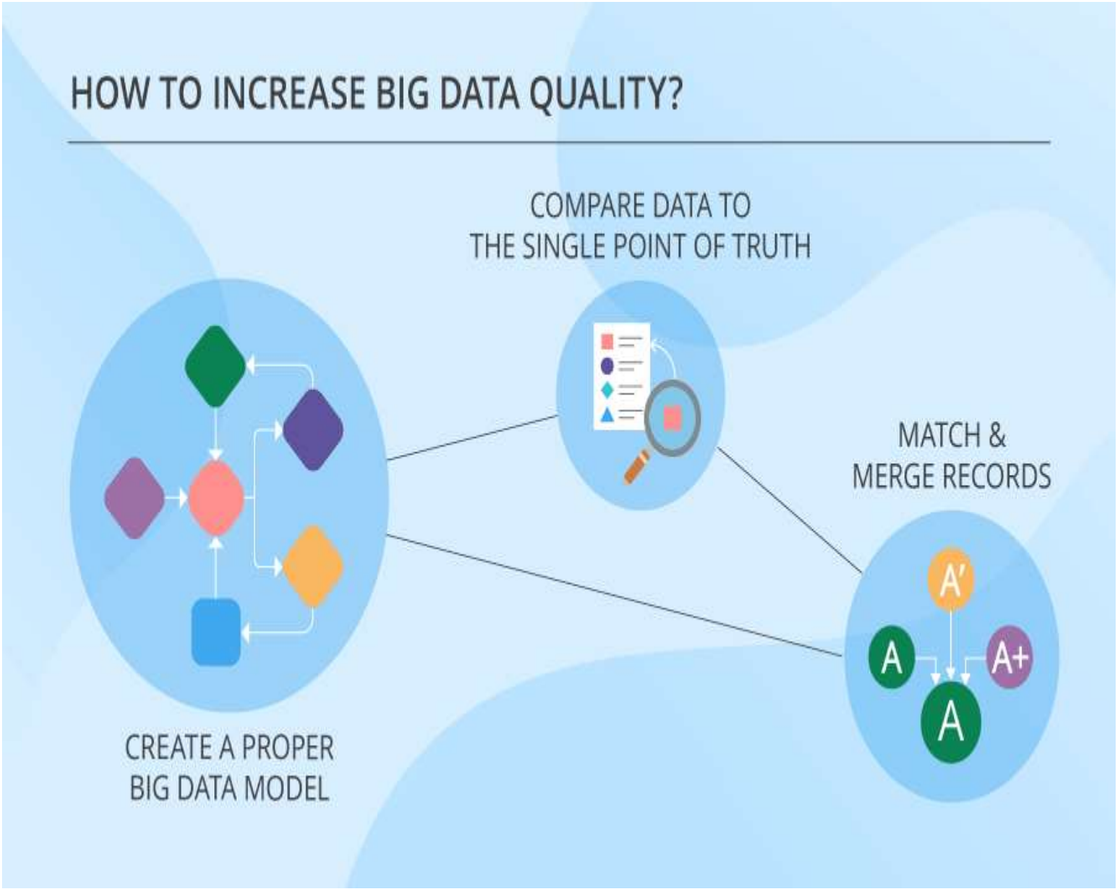


- **Confusing variety of big data technologies**

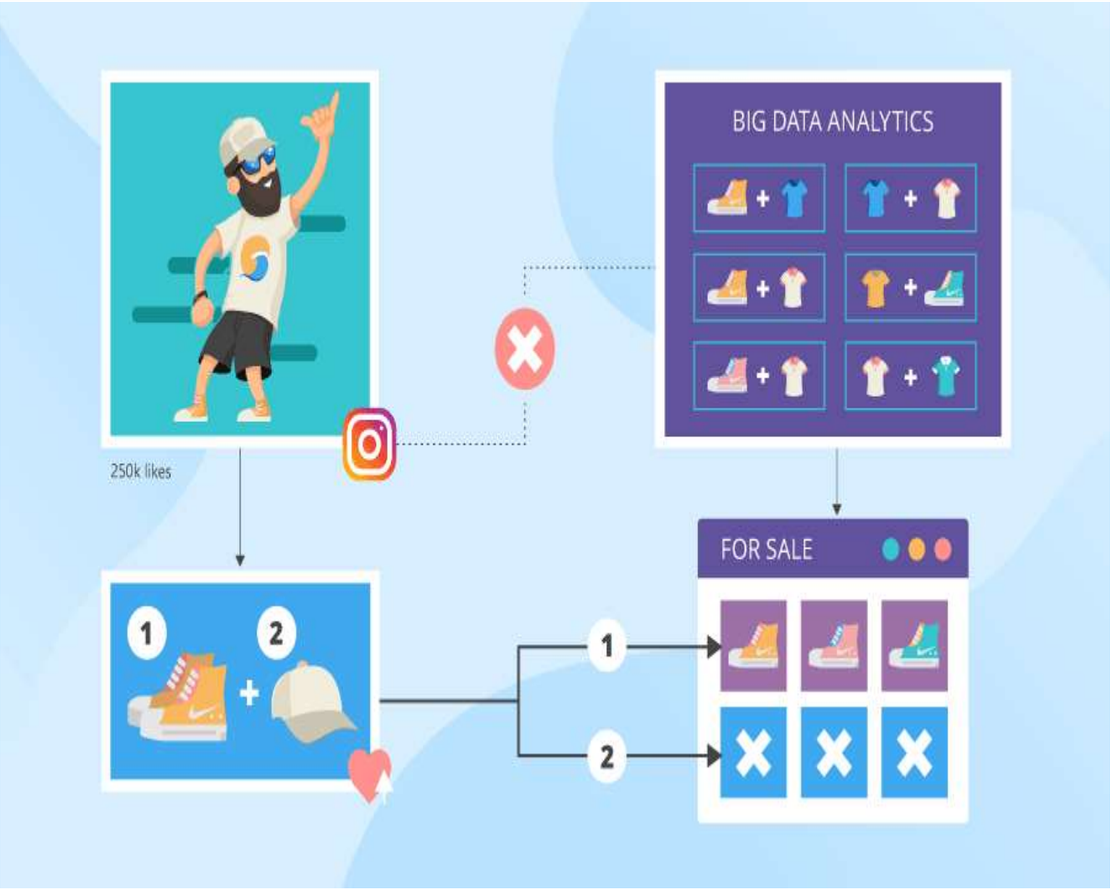
CHALLENGES WITH BIG DATA

Introduction (contd..)

- **Complexity of managing data quality**



- **Tricky process of converting big data into valuable insights**



CHALLENGES WITH BIG DATA

What is Big Data?

What happens **online** in 60 seconds?

CHALLENGES WITH BIG DATA

What is Big Data? (contd..)

What is Data?

- the quantities, characters, or symbols, …
- operations are performed by a computer on them
- may be stored and transmitted in the form of electrical signals
- recorded on magnetic, optical, or mechanical recording media.

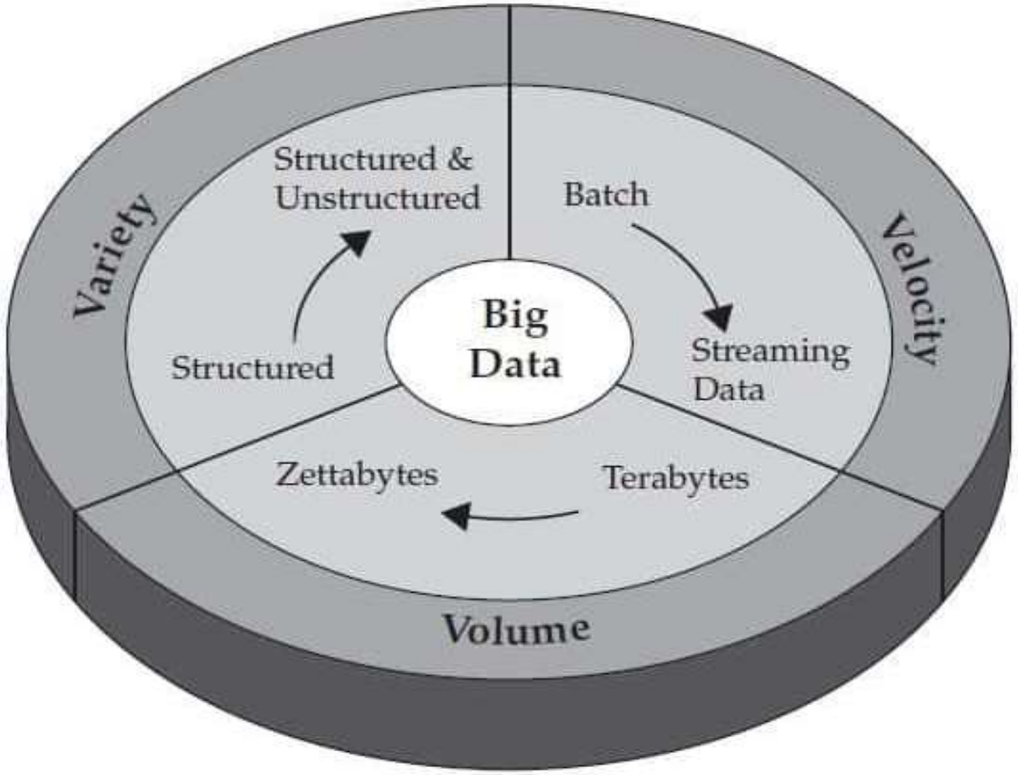
Then, What is Big Data?

- **Data** with a **huge size**
- A term used to describe a collection of huge volume of data --- yet growing exponentially with time
- **"In short such data is so large and complex that none of the traditional data management tools are able to store it or process it efficiently".**

CHALLENGES WITH BIG DATA

What is Big Data? (contd..)

What?? Definition?



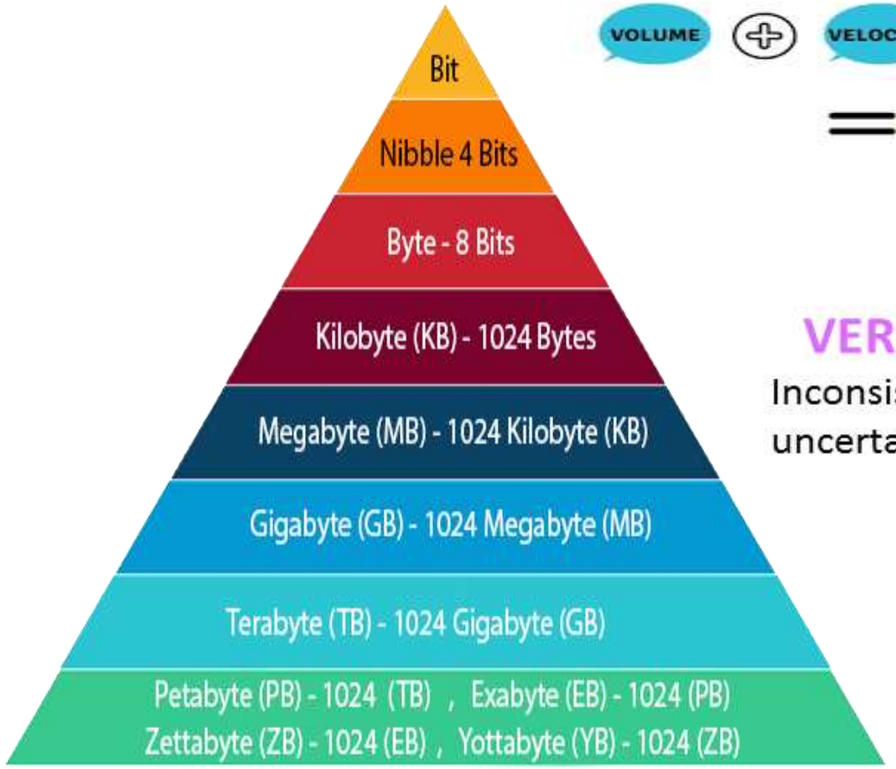
- Gartner's definition:
- **"Big data is data that contains greater variety arriving in increasing volumes and with ever-higher velocity".** --- 3Vs.
- Larger, more complex, voluminous data sets from new data sources

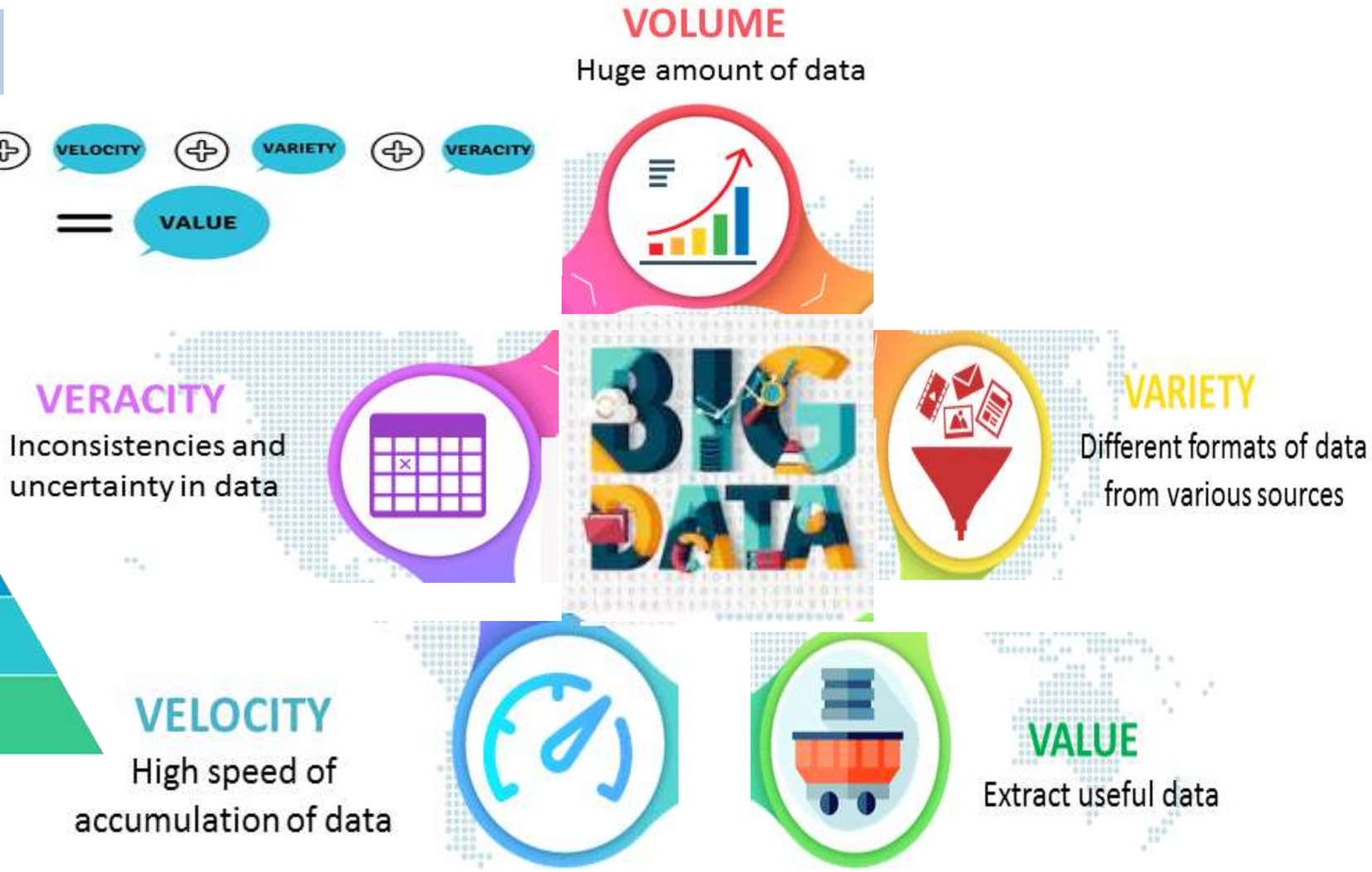
- "But it's not the amount of data that's important".
- Can be analyzed for insights --- better decisions and strategic business moves

CHALLENGES WITH BIG DATA

What is Big Data? (contd..)

Lets see Big Data with V's

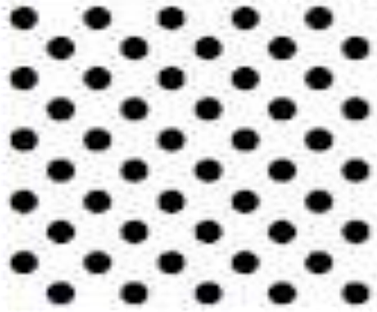
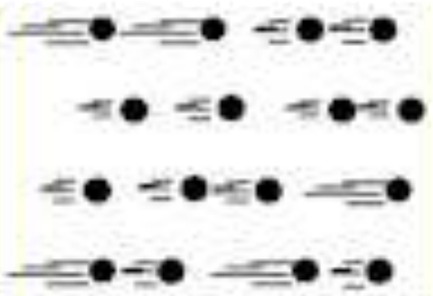
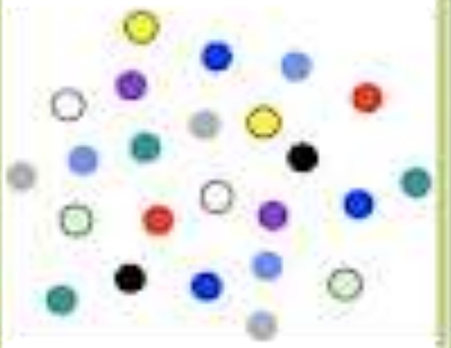




CHALLENGES WITH BIG DATA

What is Big Data? (contd..)

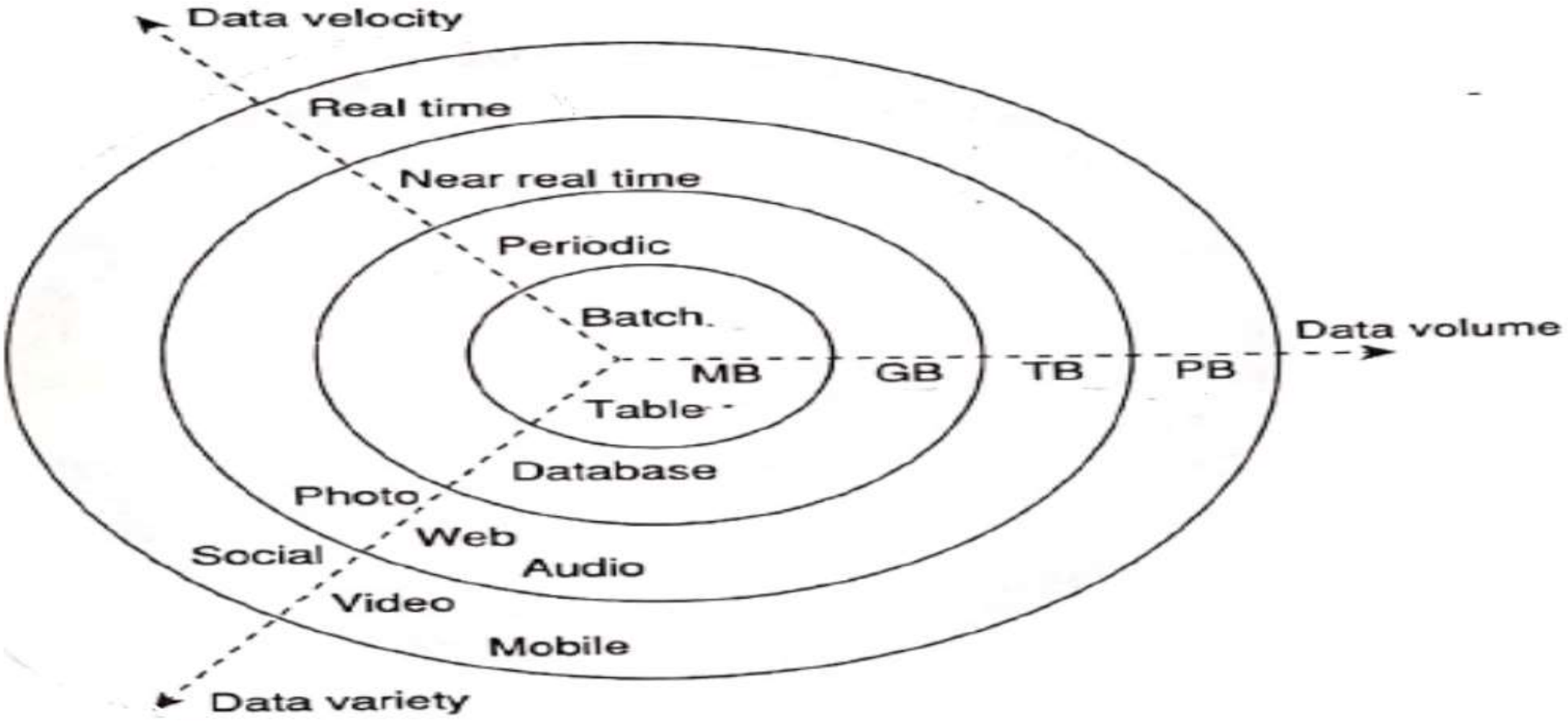
More on Big Data V's

Volume	Velocity	Variety	Veracity	Value
				
Data at Rest	**Data in Motion**	**Data in Many Forms**	**Data in Doubt**	**Data into Money**
Terabytes to Exabytes of existing data to process	Streaming data, requiring milliseconds to seconds to respond	Structured, unstructured, text, multimedia,...	Uncertainty due to data inconsistency & incompleteness, ambiguities, latency, deception, model approximations	Business models can be associated to the data

CHALLENGES WITH BIG DATA

What is Big Data? (contd..)

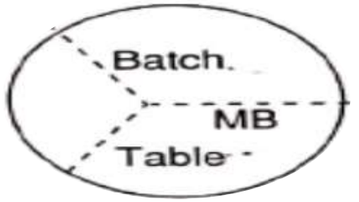
Comprehensive view

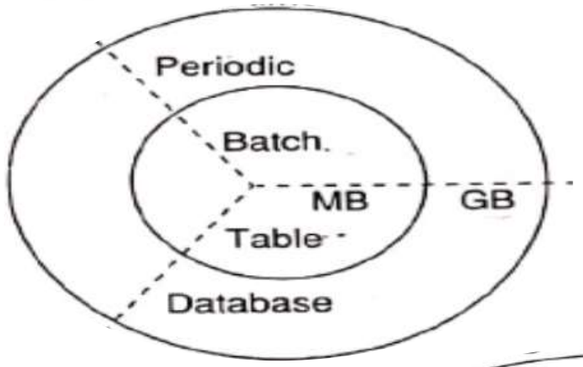


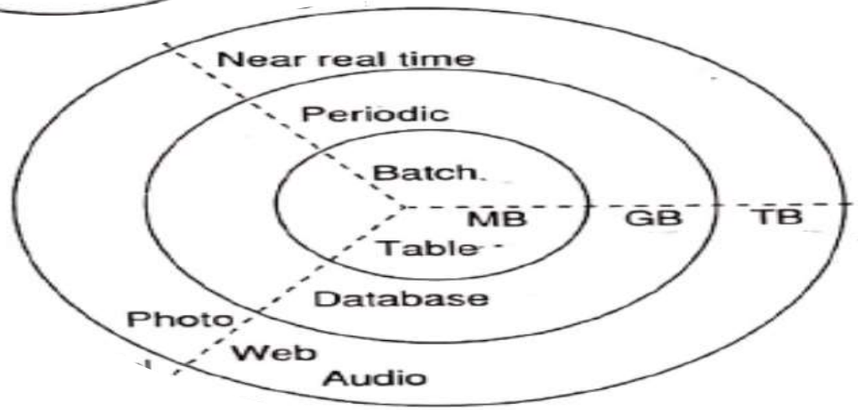
CHALLENGES WITH BIG DATA

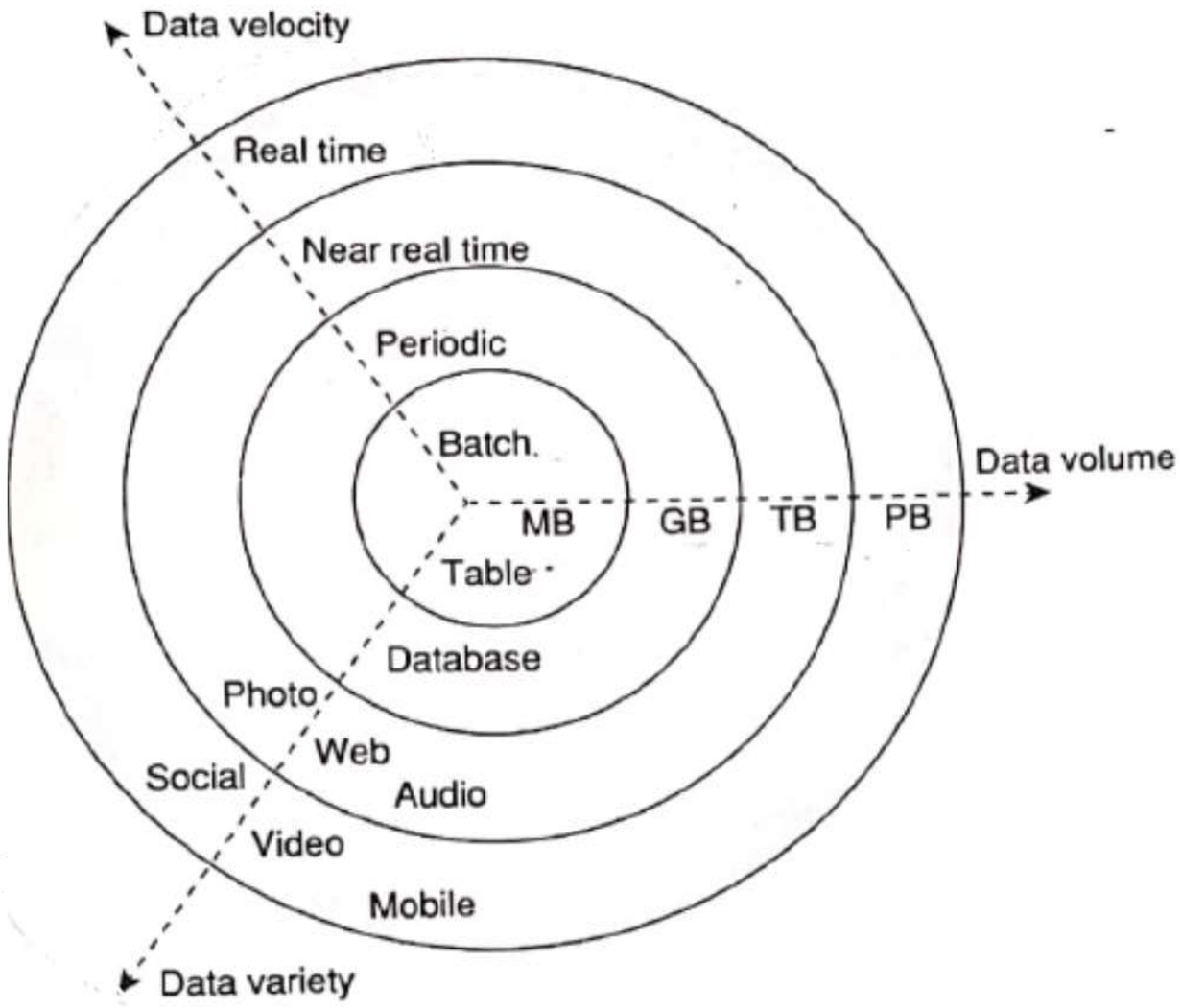
What is Big Data? (contd..)

Velocity









Batch → Periodic → Near real time → Real-time processing

CHALLENGES WITH BIG DATA

What is Big Data? (contd..)

Volume

Data Source

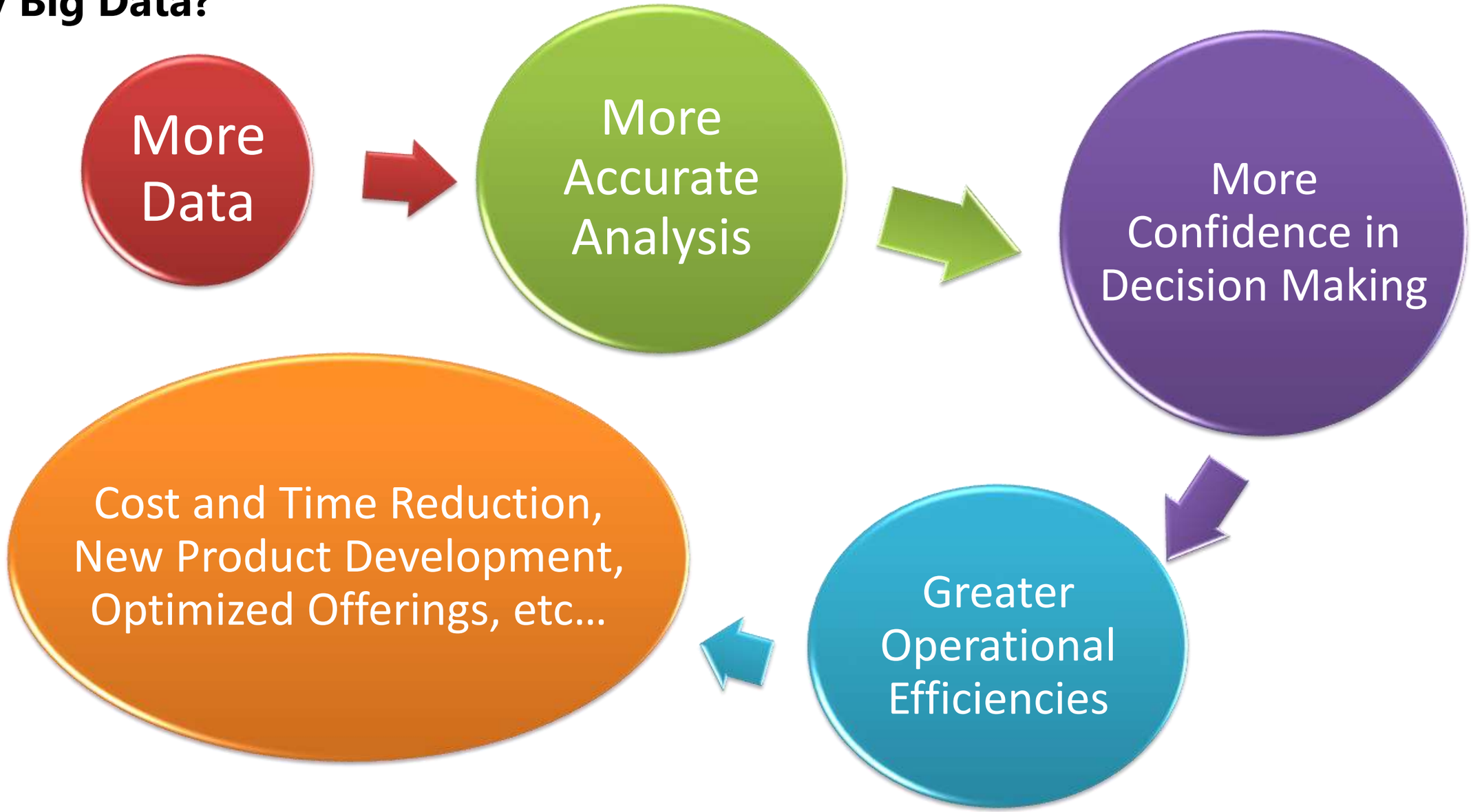
	Structured	Unstructured
Internal	**Human-Generated** • Survey ratings • Aptitude testing **Machine-Generated** • Web metrics from Web logs • Product purchase from sales Records • Process control measures	**Human-Generated** • Emails, letters, text messages • Audio transcripts • Customer comments • Voicemails • Corporate video/communications • Pictures, illustrations • Employee reviews
External	**Human-Generated** • Number of Retweets, Facebook likes, Google Plus +1s • Ratings on Yelp • Patient ratings ratings **Machine-Generated** • GPS for tweets • Time of tweet/updates/postings	**Human-Generated** • Content of social media updates • Comments in online forums • Comments on Yelp • Video reviews • Pinterest images • Surveillance video

Challenges with Big Data

Why Big Data?

CHALLENGES WITH BIG DATA

Why Big Data?



CHALLENGES WITH BIG DATA

Why is Big Data? (contd..)

Challenges with Big Data

Other Characteristics of Big Data

CHALLENGES WITH BIG DATA

Other Characteristics of Big Data

Veracity refers to biases, noise, and abnormality in data.

Validity refers to the accuracy and correctness of the data.

Volatility of data deals with, how long is the data valid? And how long should it be stored?

Variability: Data flows can be highly inconsistent with periodic peaks.

SUMMARY OF THE LECTURE

- Introduction to Challenges of Big Data
- Definition of Big Data
- What is Big Data
- Why is Big Data
- Other Characteristics of Big Data

REVA UNIVERSITY

Established as per the Section 2(f) of the UGC Act, 1956
Approved by AICTE, COA and BCI, New Delhi

Traditional BI vs Big Data Data Warehouse Environment

School of Computer Science and Engineering

AY: 2021-2022

OUTLINE

Recap of previous Lecture

Topic for the Lecture

Objective and Outcome of Lecture

Lecture Discussion

Traditional Business Intelligence

Features of Business Intelligence

Business Intelligence Applications

Small Data v/s Big Data

Business Intelligence v/s Big Data

Data Warehouse - Concept

Need for Data Warehouse

A typical Data Warehouse Environment

Data Warehouse Tools

Traditional BI vs Big Data

Recap of previous Lecture

RECAP OF PREVIOUS LECTURE

Big Data

- What is Big Data?
- Why Big Data?
- Characteristics of Big Data
- Challenges of Big Data

Traditional BI vs Big Data

Business Intelligence

TOPIC OF THE LECTURE

Business Intelligence

- Traditional Business Intelligence
- Features of Business Intelligence
- Business Intelligence Applications
- Small Data v/s Big Data
- Business Intelligence v/s Big Data

Traditional BI vs Big Data

Objective and Outcome of Lecture

OBJECTIVE AND OUTCOME OF LECTURE

Lecture Objective	Explain the different aspects of Big Data, Business Intelligence
Lecture Outcome	Paraphrase the aspects of Business Intelligence, Contrast BI and Big Data

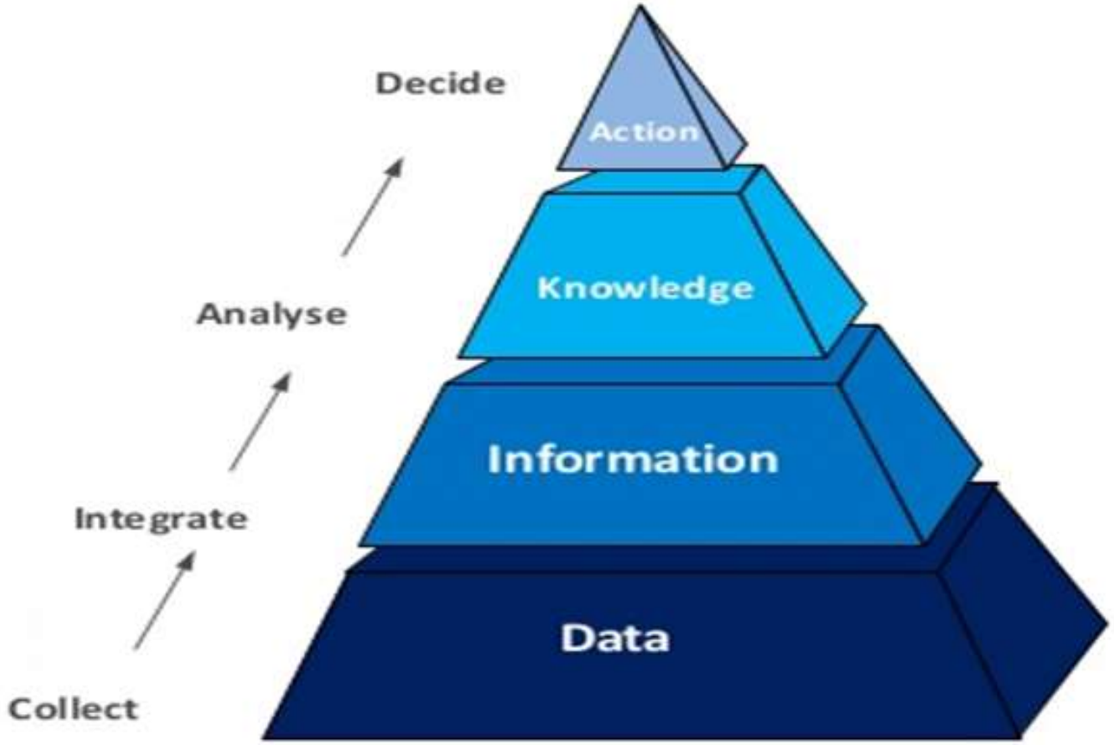
Traditional BI vs Big Data

Traditional Business Intelligence

TRADITIONAL BI VS BIG DATA

BI Definition

Business Intelligence (BI) uses a set of processes, technologies, and tools to transform raw data into meaningful information and then transform information to provide knowledge.



Traditional BI vs Big Data

BI Features

TRADITIONAL BI VS BIG DATA

BI Features

Enables users to predict customer behavior, forecast demand, and prepare strategies using modeling, statistics, machine learning, and data mining tools.

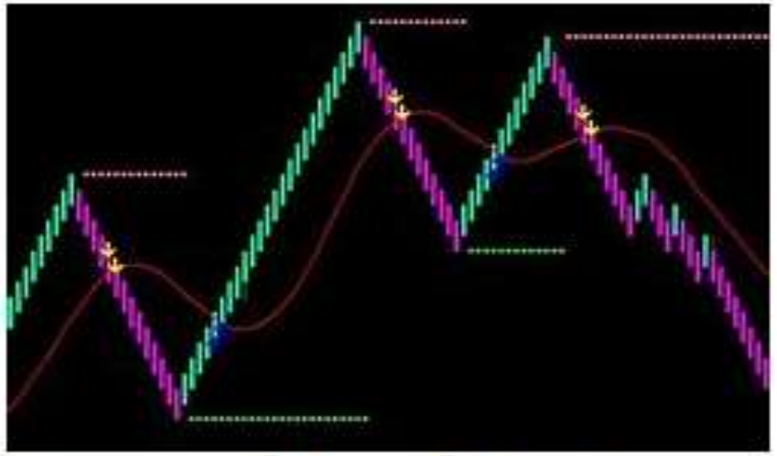
TRADITIONAL BI VS BIG DATA

BI Features

Online analytical processing helps users view a data slice from different viewpoints and improves reporting capabilities.

TRADITIONAL BI VS BIG DATA

BI Features



Trend Indicators

Help users spot patterns in production, sales, and distribution lines and identifies anomalies.

TRADITIONAL BI VS BIG DATA

BI Features

Allow users to create high-level financial and operational plans based on past performances and future goals.

Traditional BI vs Big Data

BI Applications

TRADITIONAL BI VS BIG DATA

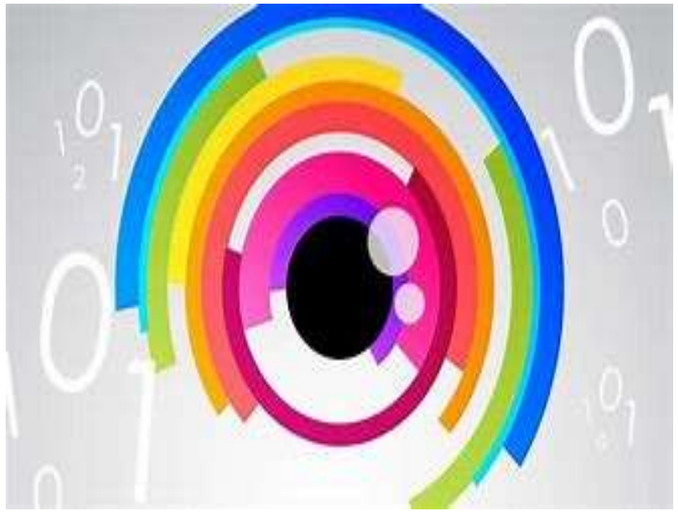
BI Applications

Sales Intelligence

A key application of BI focuses on where your business meets the customer.

TRADITIONAL BI VS BIG DATA

BI Applications



Visualization

Utilizes a range of data analytic tools to visualize

TRADITIONAL BI VS BIG DATA

BI Applications

Reporting

A crucial business application of BI is reporting.

TRADITIONAL BI VS BIG DATA

BI Applications

Performance management
organizations can monitor goal progress based on pre-defined or customizable timeframes.

TRADITIONAL BI VS BIG DATA

BI Applications

Knowledge management

It is concerned with the creation, distribution, use, and management of business intelligence

Traditional BI vs Big Data

Small Data v/s Big Data

TRADITIONAL BI VS BIG DATA

Small Data v/s Big Data

	Small Data	Big Data
Data Condition	Ready for analysis, Flat files, no need of merging tables	Always Unstructured, not ready for analysis, many relational database tables that need merging
Location	Database, Local PC	Cloud, offshore, SQL Server etc.
Data Size	File that is in a spreadsheet, files that can be viewed on a few sheets of paper	Over 50K Variables, over 50K individual random samples, unstructured
Data Purpose	Intended purpose for Data Collection	No intended purpose

Traditional BI vs Big Data

Business Intelligence v/s Big Data

TRADITIONAL BI V/S BIG DATA

Business Intelligence v/s Big Data

	Business Intelligence	Big Data
Data Storage	All the enterprise's data is stored in a central server	Data resides in a distributed file
Data Analysis	Data is generally analysed in an offline mode	Data is analysed in both in real times as well as offline mode
Data type	It is about structured	It is about structured, semi-structured and unstructured
Data Processing	data is taken to processing functions (move data to code)	processing functions are taken to data (move code to data)

DATA WAREHOUSE ENVIRONMENT

Data Warehouse - Concept

A **Data Warehouse** is different from DBMS, it stores huge amount of data, which is typically collected from multiple heterogeneous source like files, DBMS, etc.

The **goal** is to produce statistical results that may help in decision making.

Data Warehouse Environment

Need for Data Warehouse

DATA WAREHOUSE ENVIRONMENT

Need for Data Warehouse

Goal of any business: To make better Decisions

Eg: E-Commerce

We maintain data like

- Product details
- Customer Login Credentials
- Checkout details
- Merchant Account
- Other Information

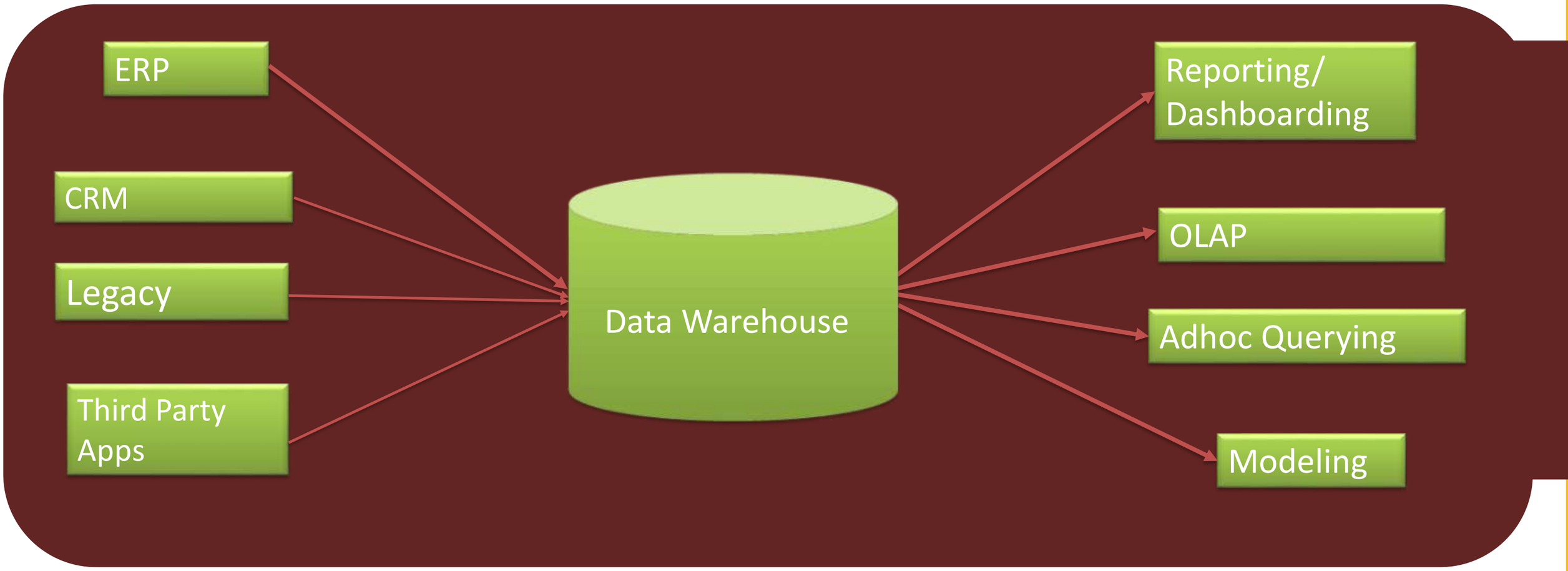
Need: Concepts to be Extracted on a periodic basis, Formatted, Summarized and Supplemented.

Data Warehouse Environment

A typical Data Warehouse Environment

DATA WAREHOUSE ENVIRONMENT

A typical Data Warehouse Environment



DATA WAREHOUSE ENVIRONMENT

A typical Data Warehouse Environment

ERP: enterprise resource planning, the management of all the information and resources involved in a company's operations by means of an integrated computer system.

CRM: customer relationship management, denoting strategies and software that enable a company to optimize its customer relations.

Legacy: denoting or relating to software or hardware that has been superseded but is difficult to replace because of its wide use.

A third-party apps : Is an application created by a developer that isn't the manufacturer of the device the app runs on or the owner of the website that offers it.

DATA WAREHOUSE ENVIRONMENT

A typical Data Warehouse Environment

Reporting: Is used to generate human-readable reports from various data sources..

OLAP: Online analytical processing is a computer-based technique of analyzing data to look for insights.

Ad hoc query: ad hoc query is a loosely typed command/query whose value depends upon some variable

Modeling: is a graphical view of data created for analysis and design purposes.

Data Warehouse Environment

Data Warehouse Tools

DATA WAREHOUSE ENVIRONMENT

Data Warehouse Tools

SUMMARY OF THE LECTURE

- Business Intelligence
- Big Data
- Business Intelligence v/s Big Data
- Data Warehouse
- Need for Data Warehouse, Architecture Tools

THANK YOU