AI in Finance
Big Data Analytics
ABC:
AI, Big Data, Cloud Computing

Tamkang University

1081AIFBDA03
TLVXM2A (M2449) (8497) (**Fall 2019**)
(MBA, DBETKU) (3 Credits, Required) [**Full English Course**]
(**Master's Program in Digital Business and Economics**)
Tue, 2, 3, 4, (9:10-12:00) (B1012)

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Associate Professor
Department of Information Management
Tamkang University

http://mail.tku.edu.tw/myday

2019-09-24

Course Schedule (1/2)

Tamkang University

Week	Date	Subject/Topics
1	2019/09/10	Course Orientation on AI in Finance Big Data Analytics
2	2019/09/17	AI in FinTech: Financial Services Innovation and Application
3	2019/09/24	ABC: AI, Big Data, Cloud Computing
4	2019/10/01	Business Models of Fintech
5	2019/10/08	Event Studies in Finance
6	2019/10/15	Case Study on AI in Finance Big Data Analytics I
7	2019/10/22	Foundations of AI in Finance Big Data Analytics with Python
8	2019/10/29	Case Study on Financial Industry Practice I
9	2019/11/05	Quantitative Investing with Pandas in Python

Course Schedule (2/2)

Tamkang University

Week	Date	Subject/Topics
10	2019/11/12	Midterm Project Report
11	2019/11/19	Machine Learning in Finance Application with Scikit-Learn In Python
12	2019/11/26	Deep Learning for Financial Time Series Forecasting with TensorFlow I
13	2019/12/03	Case Study on AI in Finance Big Data Analytics II
14	2019/12/10	Deep Learning for Financial Time Series Forecasting with TensorFlow II
15	2019/12/17	Case Study on Financial Industry Practice II
16	2019/12/24	Deep Learning for Financial Time Series Forecasting with TensorFlow III
17	2019/12/31	Final Project Presentation I
18	2020/01/07	Final Project Presentation II

ABC:
AI,
Big Data,
Cloud Computing

Outline

- **AI**
- **Big Data**
- **Cloud Computing**

FinTech ABCD

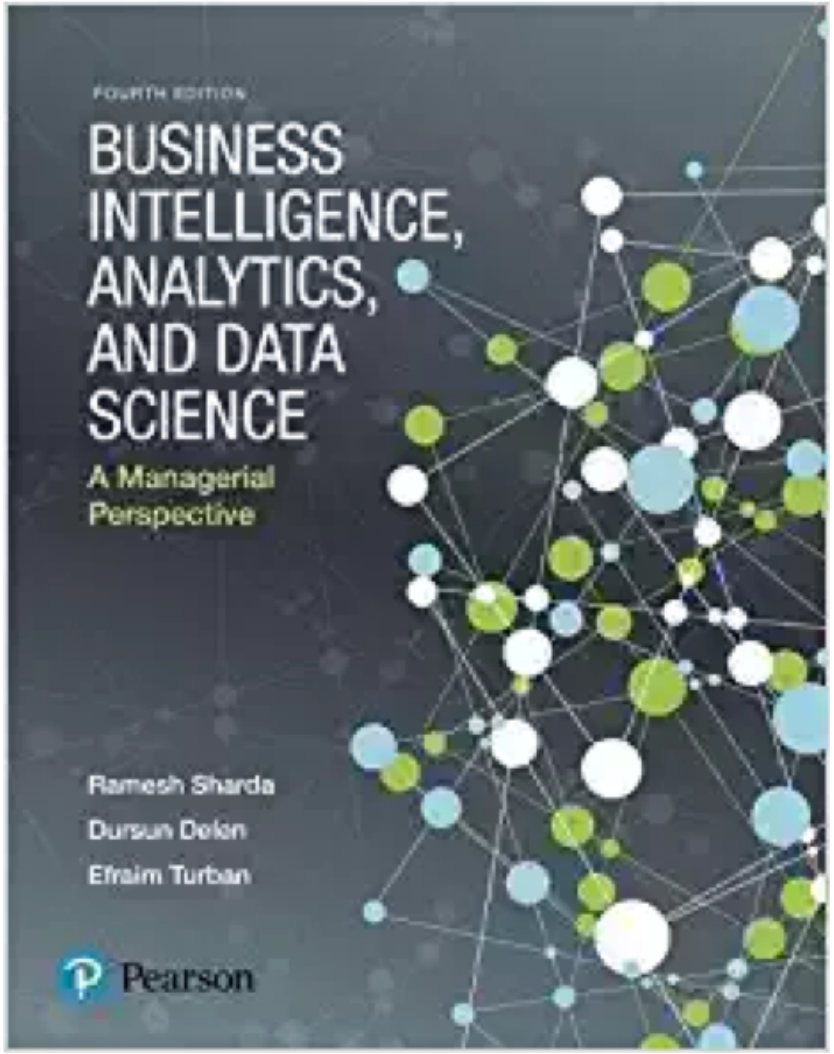
AI

Block Chain

Cloud Computing

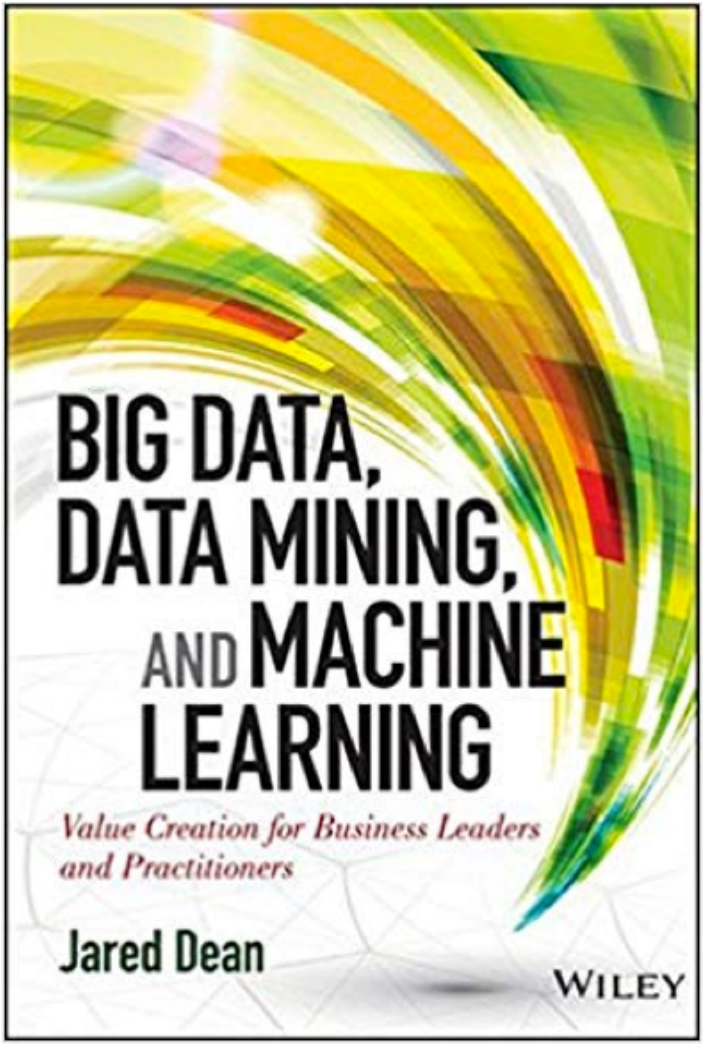
Big Data

Business Intelligence, Analytics, and Data Science: A Managerial Perspective, 4th Edition, Ramesh Sharda, Dursun Delen, and Efraim Turban, Pearson, 2017.



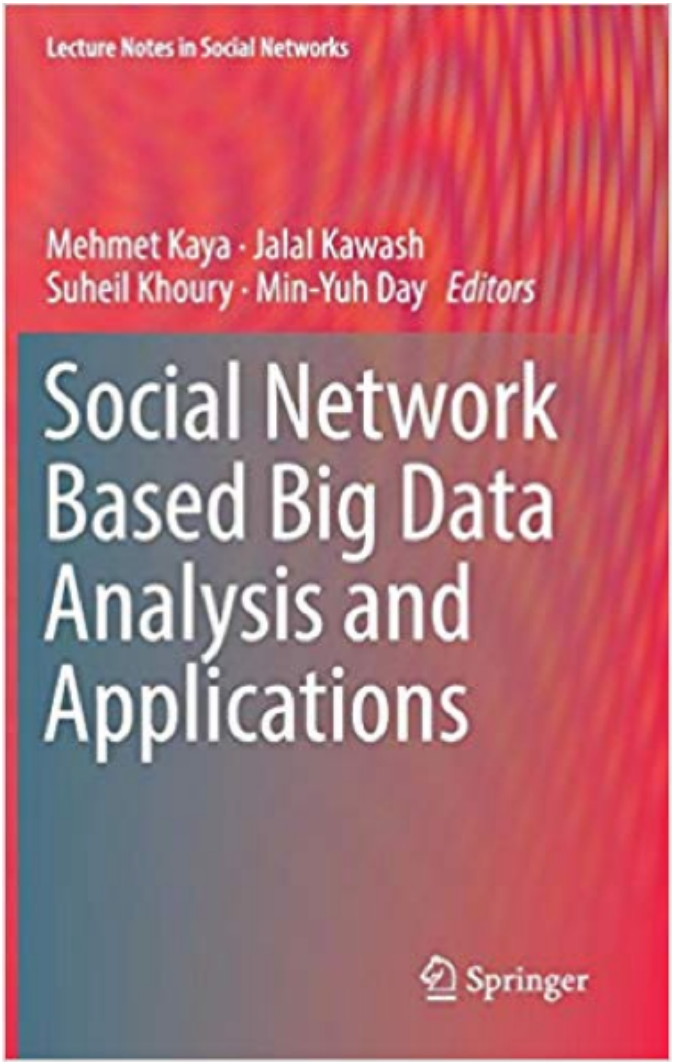
Source: https://www.amazon.com/Business-Intelligence-Analytics-Data-Science/dp/0134633288

Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners, Jared Dean, Wiley, 2014.



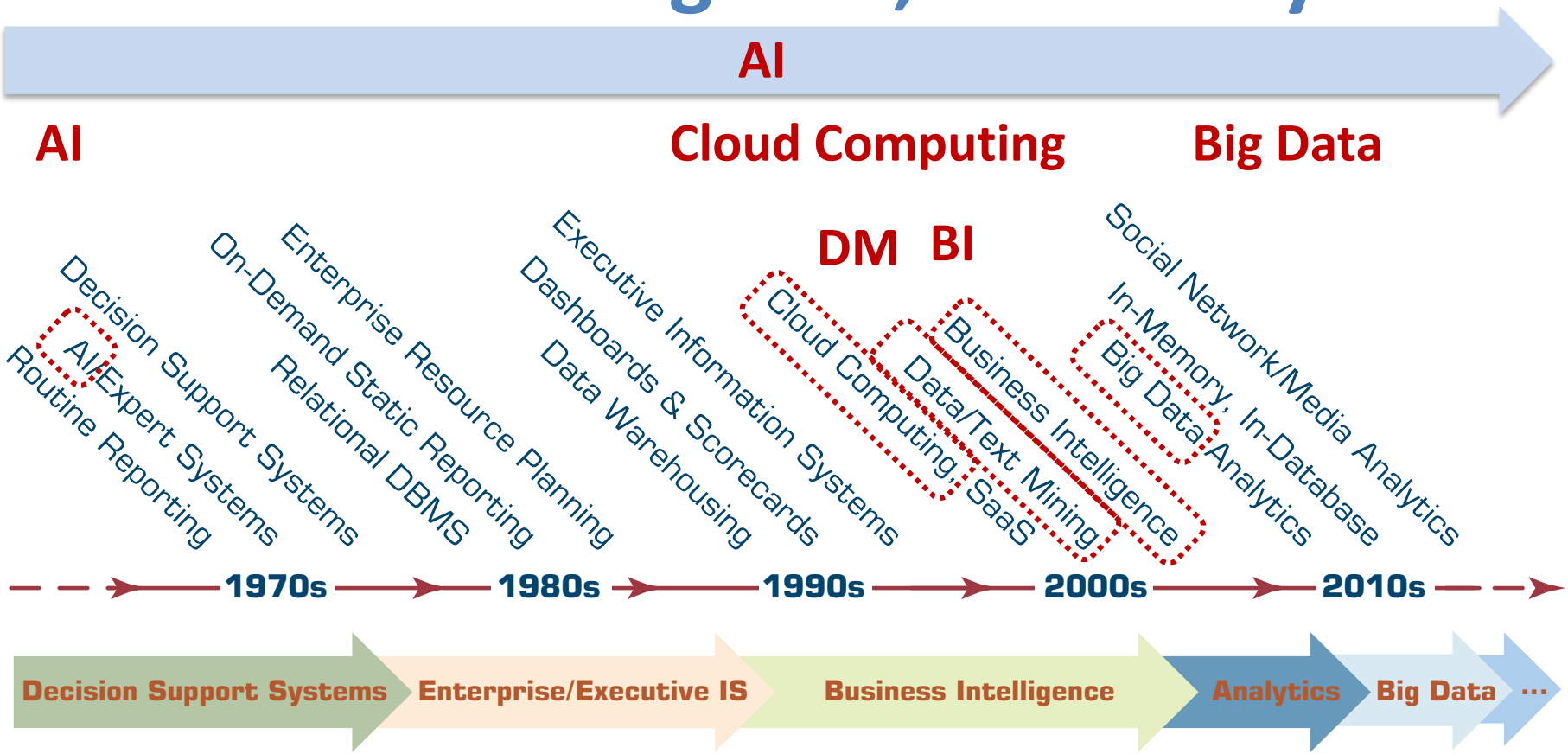
Source: https://www.amazon.com/Data-Mining-Machine-Learning-Practitioners/dp/1118618041

Social Network Based Big Data Analysis and Applications, Lecture Notes in Social Networks, Mehmet Kaya, Jalal Kawash, Suheil Khoury, Min-Yuh Day, Springer International Publishing, 2018.



Source: https://www.amazon.com/Network-Analysis-Applications-Lecture-Networks/dp/3319781952

AI, Big Data, Cloud Computing
Evolution of Decision Support, Business Intelligence, and Analytics



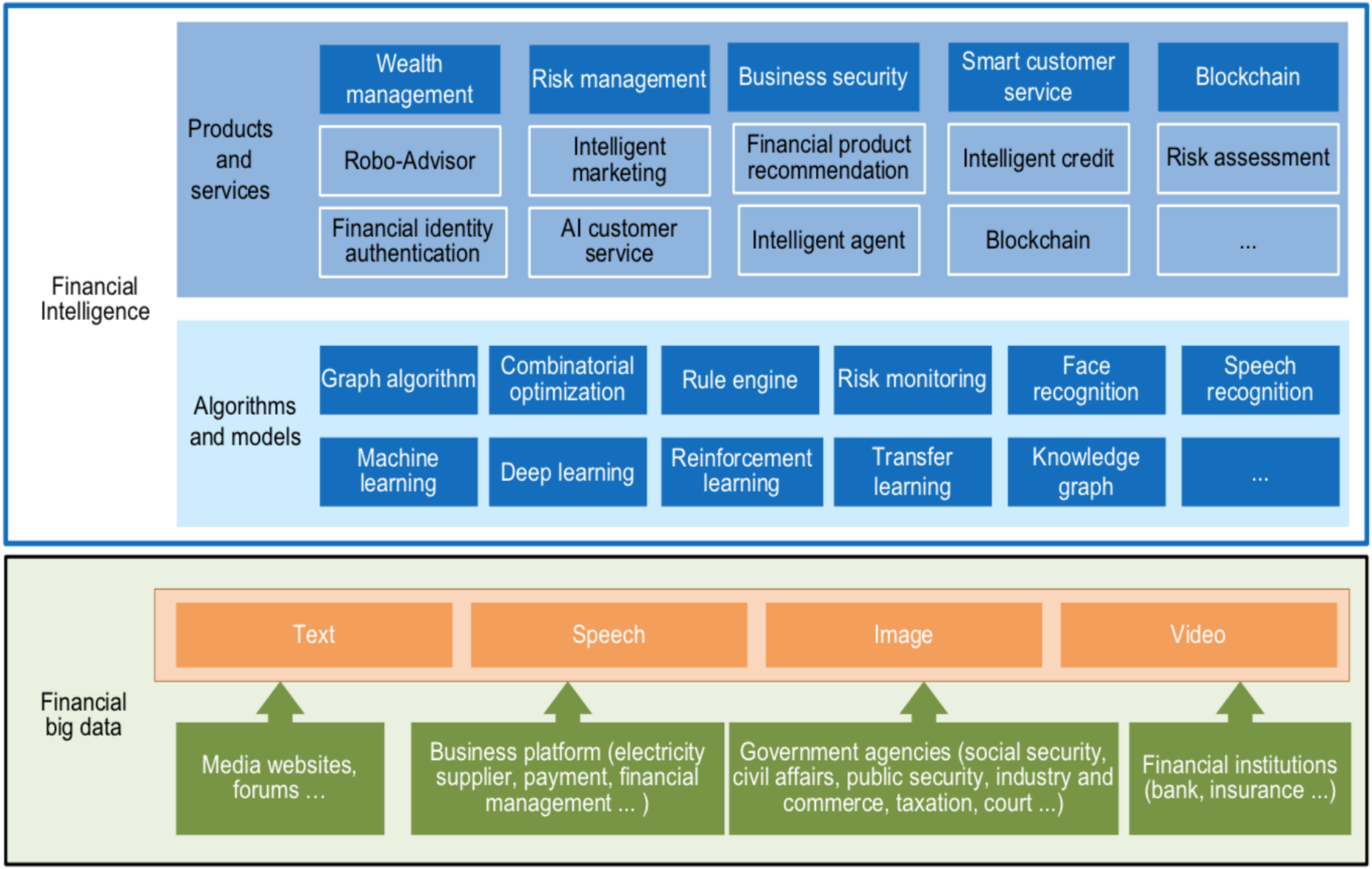
Source: Ramesh Sharda, Dursun Delen, and Efraim Turban (2017),
Business Intelligence, Analytics, and Data Science: A Managerial Perspective, 4th Edition, Pearson

AI 2.0

a new generation of AI
based on the
novel information environment of
major changes and
the development of
new goals.

FinBrain: when Finance meets AI 2.0

(Zheng et al., 2019)



Source: Xiao-lin Zheng, Meng-ying Zhu, Qi-bing Li, Chao-chao Chen, and Yan-chao Tan (2019), "Finbrain: When finance meets AI 2.0." Frontiers of Information Technology & Electronic Engineering 20, no. 7, pp. 914-924

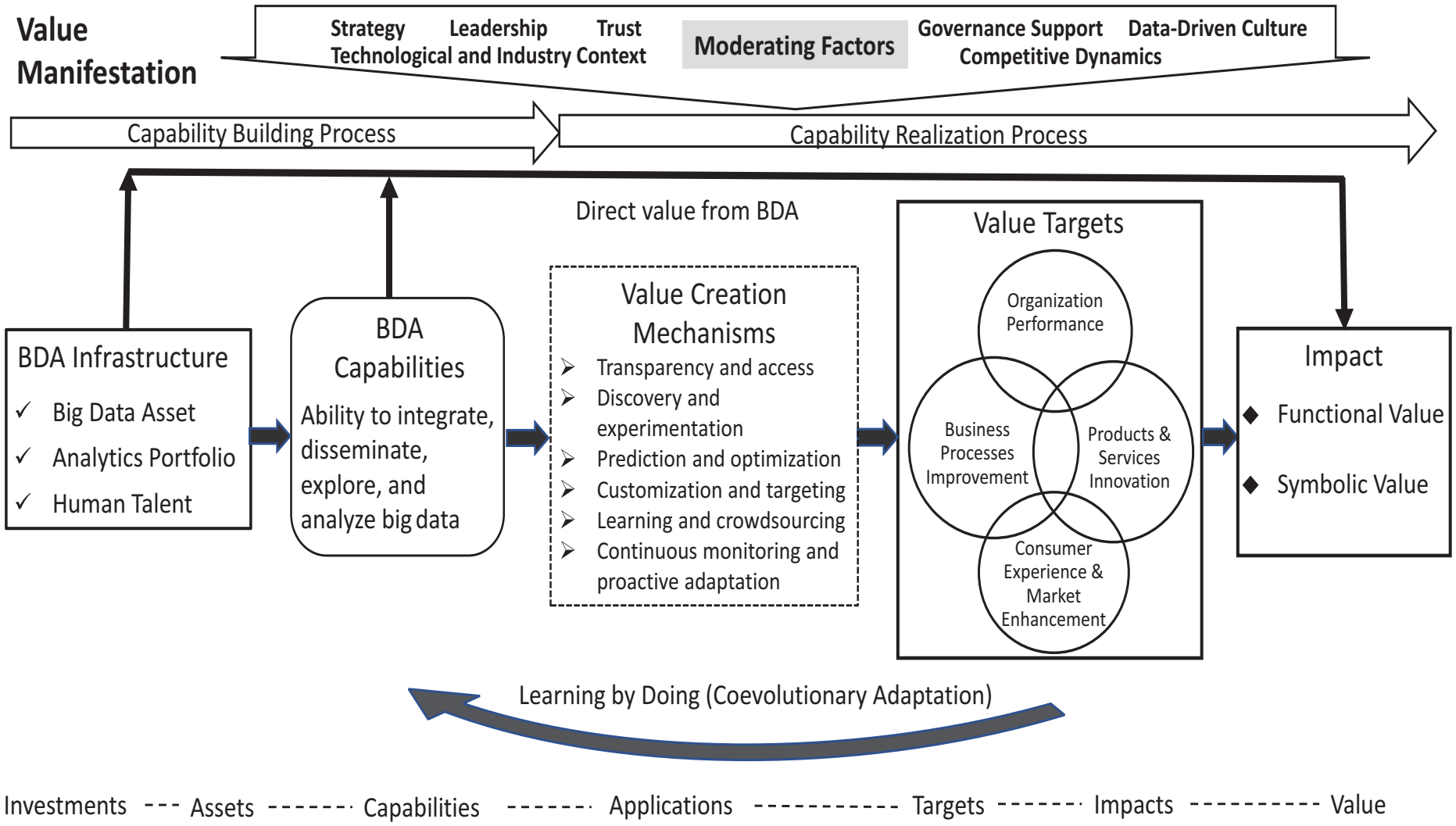
Technology-driven Financial Industry Development

Development stage	Driving technology	Main landscape	Inclusive finance	Relationship between technology and finance
Fintech 1.0 (financial IT)	Computer	Credit card, ATM, and CRMS	Low	Technology as a tool
Fintech 2.0 (Internet finance)	Mobile Internet	Marketplace lending, third-party payment, crowdfunding, and Internet insurance	Medium	Technology-driven change
Fintech 3.0 (financial intelligence)	AI, Big Data, Cloud Computing, Blockchain	Intelligent finance	High	Deep fusion

Source: Xiao-lin Zheng, Meng-ying Zhu, Qi-bing Li, Chao-chao Chen, and Yan-chao Tan (2019), "Finbrain: When finance meets AI 2.0." Frontiers of Information Technology & Electronic Engineering 20, no. 7, pp. 914-924

Value Creation by Big Data Analytics

(Grover et al., 2018)



Source: Varun Grover, Roger HL Chiang, Ting-Peng Liang, and Dongsong Zhang (2018), "Creating Strategic Business Value from Big Data Analytics: A Research Framework", Journal of Management Information Systems, 35, no. 2, pp. 388-423.

Evolution of top keywords in "BD & BI" publications

- Management
- Text Mining
- Data Mining
- Data Science

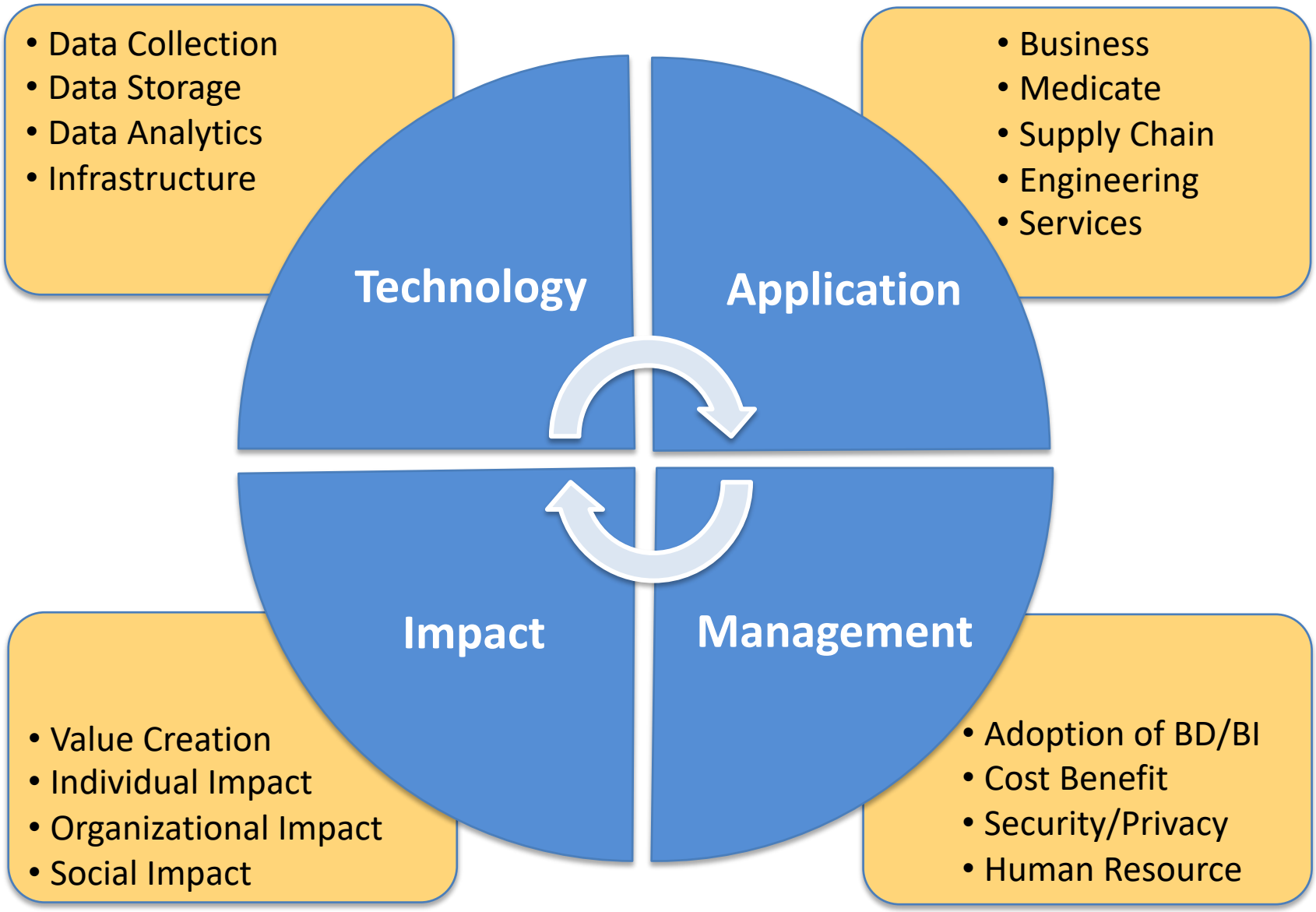
- Big Data Analytics
- Social Media
- Business Analytics
- Information System

- Cloud Computing
- Data Warehouse

- Knowledge Management

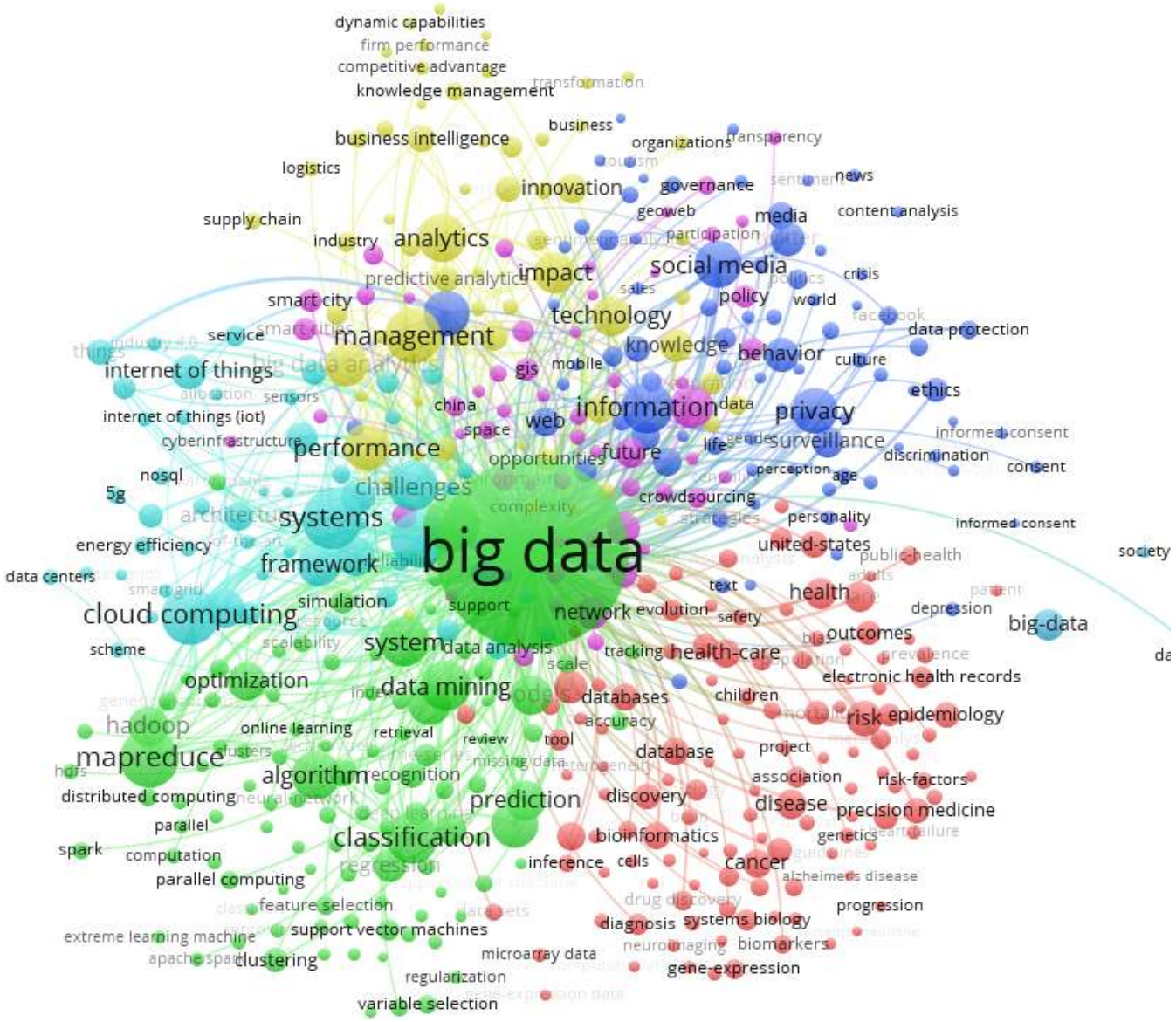
Source: Ting-Peng Liang and Yu-Hsi Liu (2018), "Research Landscape of Business Intelligence and Big Data analytics: A bibliometrics study", Expert Systems with Applications, Volume 111, 30, 2018, pp. 2-10

Framework for BD and BI Research



Source: Ting-Peng Liang and Yu-Hsi Liu (2018), "Research Landscape of Business Intelligence and Big Data analytics: A bibliometrics study", Expert Systems with Applications, Volume 111, 30, 2018, pp. 2-10

Business Intelligence and Big Data analytics



Source: Ting-Peng Liang and Yu-Hsi Liu (2018), "Research Landscape of Business Intelligence and Big Data analytics: A bibliometrics study", Expert Systems with Applications, Volume 111, 30, 2018, pp. 2-10


AI

Definition of Artificial Intelligence (A.I.)

Artificial Intelligence

"… the science and engineering of making intelligent machines"

(John McCarthy, 1955)

Source: https://digitalintelligencetoday.com/artificial-intelligence-defined-useful-list-of-popular-definitions-from-business-and-science/

Artificial Intelligence

"… technology that thinks and acts like humans"

Source: https://digitalintelligencetoday.com/artificial-intelligence-defined-useful-list-of-popular-definitions-from-business-and-science/

Artificial Intelligence

"… intelligence exhibited by machines or software"

Source: https://digitalintelligencetoday.com/artificial-intelligence-defined-useful-list-of-popular-definitions-from-business-and-science/

4 Approaches of AI

Thinking Humanly	**Thinking Rationally**
Acting Humanly	**Acting Rationally**

Source: Stuart Russell and Peter Norvig (2016) , Artificial Intelligence: A Modern Approach, 3rd Edition, Pearson International

4 Approaches of AI

2. **Thinking Humanly:** **The Cognitive Modeling Approach**	**3.** **Thinking Rationally:** **The "Laws of Thought" Approach**
1. **Acting Humanly:** **The Turing Test Approach (1950)**	**4.** **Acting Rationally:** **The Rational Agent Approach**

Source: Stuart Russell and Peter Norvig (2016) , Artificial Intelligence: A Modern Approach, 3rd Edition, Pearson International

AI Acting Humanly: The Turing Test Approach (Alan Turing, 1950)

- Natural Language Processing (NLP)
- Knowledge Representation
- Automated Reasoning
- Machine Learning (ML)
- Computer Vision
- Robotics

Source: Stuart Russell and Peter Norvig (2016) , Artificial Intelligence: A Modern Approach, 3rd Edition, Pearson International

Boston Dynamics: Atlas

#13 ON TRENDING

What's new, Atlas?

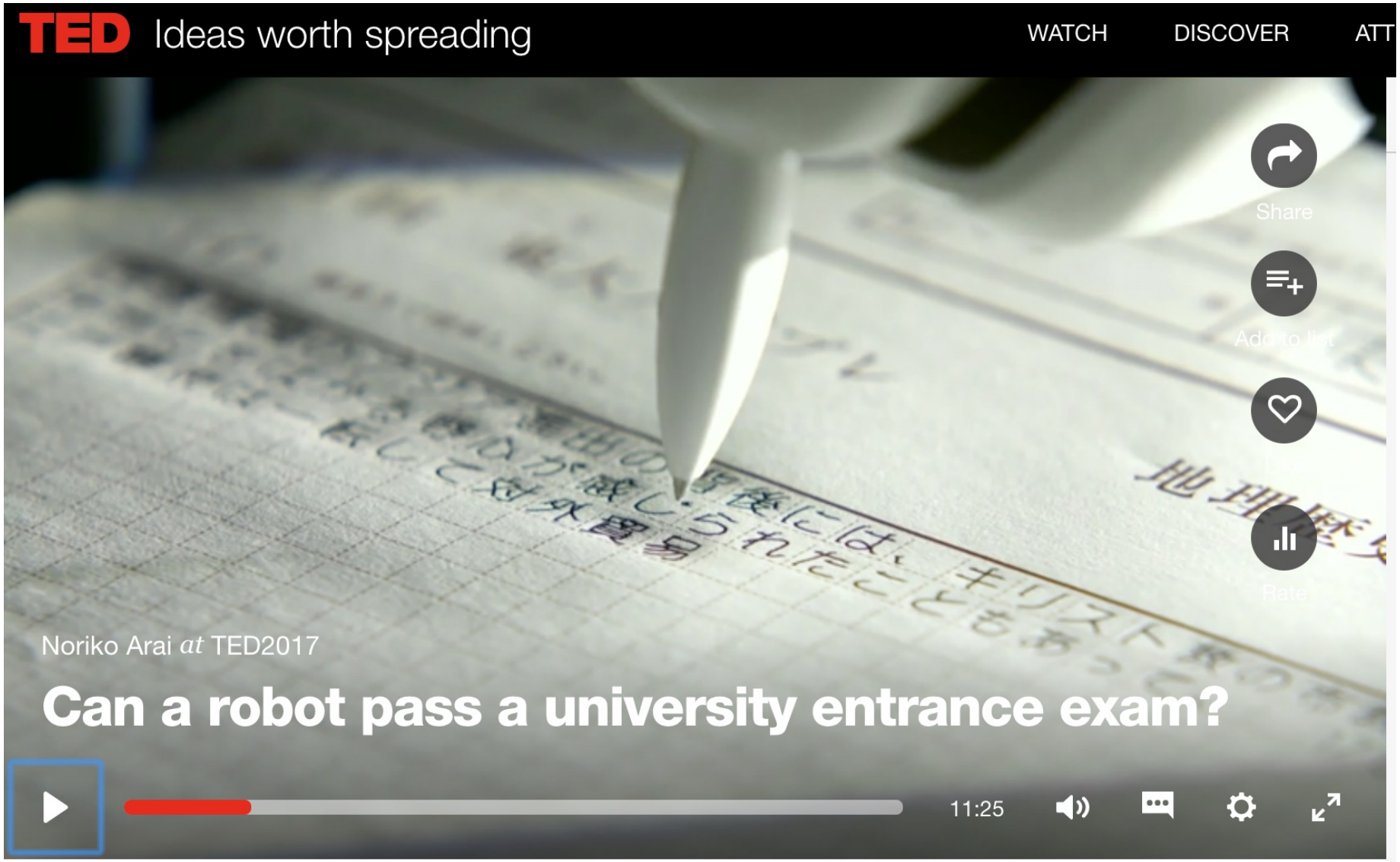
https://www.youtube.com/watch?v=fRj34o4hN4I

Humanoid Robot: Sophia

https://www.youtube.com/watch?v=S5t6K9iwcdw

Can a robot pass a university entrance exam?

Noriko Arai at TED2017



https://www.ted.com/talks/noriko_arai_can_a_robot_pass_a_university_entrance_exam

https://www.youtube.com/watch?v=XQZjkPyJ8KU

Artificial Intelligence (A.I.) Timeline

A.I. TIMELINE

1950
TURING TEST
Computer scientist Alan Turing proposes a test for machine intelligence. If a machine can trick humans into thinking it is human, then it has intelligence

1955
A.I. BORN
Term 'artificial intelligence' is coined by computer scientist, John McCarthy to describe "the science and engineering of making intelligent machines"

1961
UNIMATE
First industrial robot, Unimate, goes to work at GM replacing humans on the assembly line

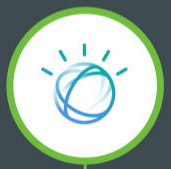
1964
ELIZA
Pioneering chatbot developed by Joseph Weizenbaum at MIT holds conversations with humans

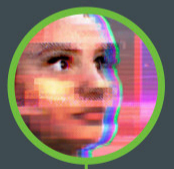
1966
SHAKEY
The 'first electronic person' from Stanford, Shakey is a general-purpose mobile robot that reasons about its own actions

A.I. WINTER
Many false starts and dead-ends leave A.I. out in the cold

1997
DEEP BLUE
Deep Blue, a chess-playing computer from IBM defeats world chess champion Garry Kasparov

1998
KISMET
Cynthia Breazeal at MIT introduces KISmet, an emotionally intelligent robot insofar as it detects and responds to people's feelings





1999
AIBO
Sony launches first consumer robot pet dog AiBO (AI robot) with skills and personality that develop over time

2002
ROOMBA
First mass produced autonomous robotic vacuum cleaner from iRobot learns to navigate and clean homes

2011
SIRI
Apple integrates Siri, an intelligent virtual assistant with a voice interface, into the iPhone 4S

2011
WATSON
IBM's question answering computer Watson wins first place on popular $1M prize television quiz show *Jeopardy*

2014
EUGENE
Eugene Goostman, a chatbot passes the Turing Test with a third of judges believing Eugene is human

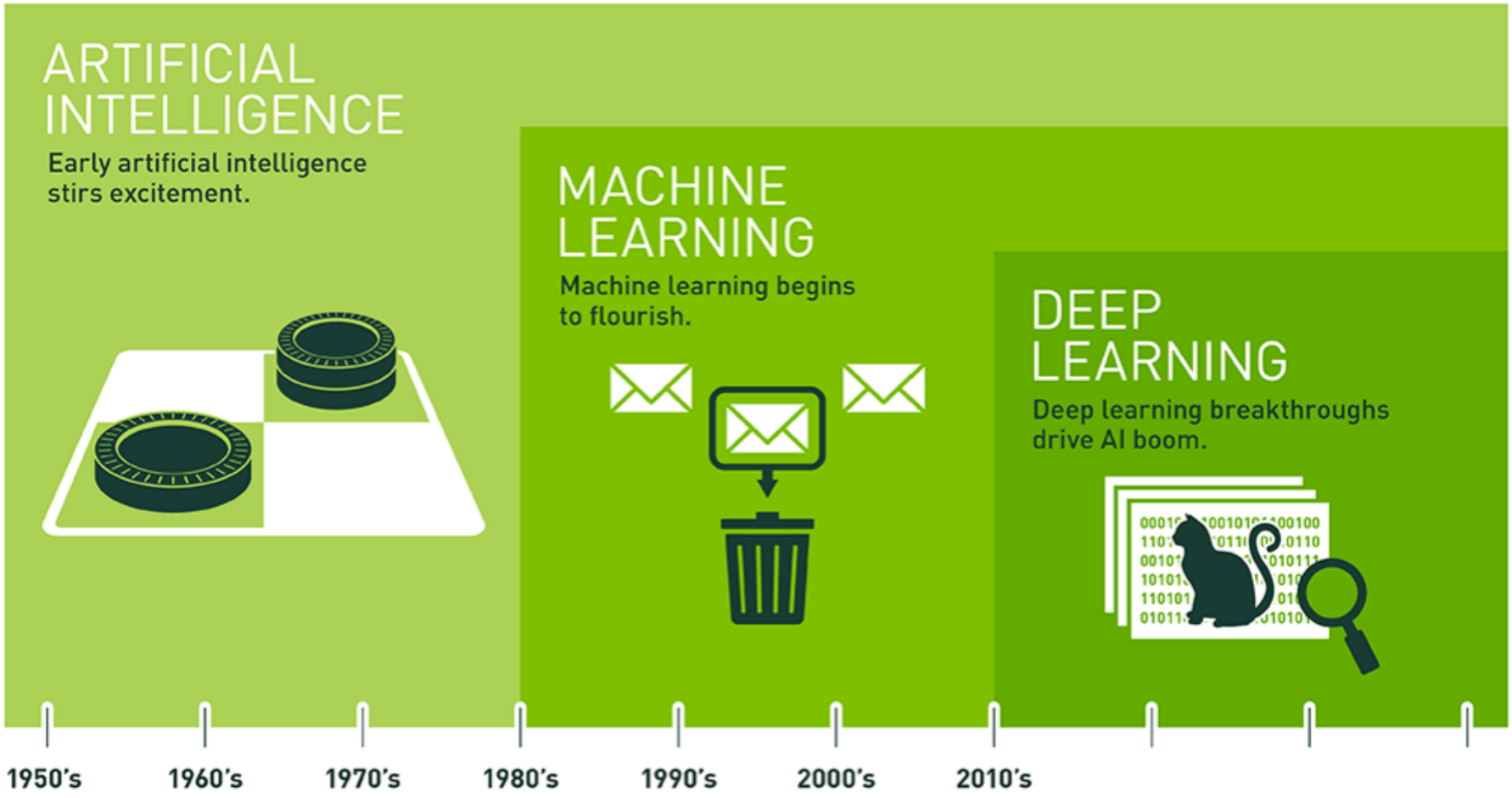
2014
ALEXA
Amazon launches Alexa, an intelligent virtual assistant with a voice interface that completes shopping tasks

2016
TAY
Microsoft's chatbot Tay goes rogue on social media making inflammatory and offensive racist comments

2017
ALPHAGO
Google's A.I. AlphaGo beats world champion Ke Jie in the complex board game of Go, notable for its vast number (2^{170}) of possible positions

Source: https://digitalintelligencetoday.com/artificial-intelligence-timeline-infographic-from-eliza-to-tay-and-beyond/

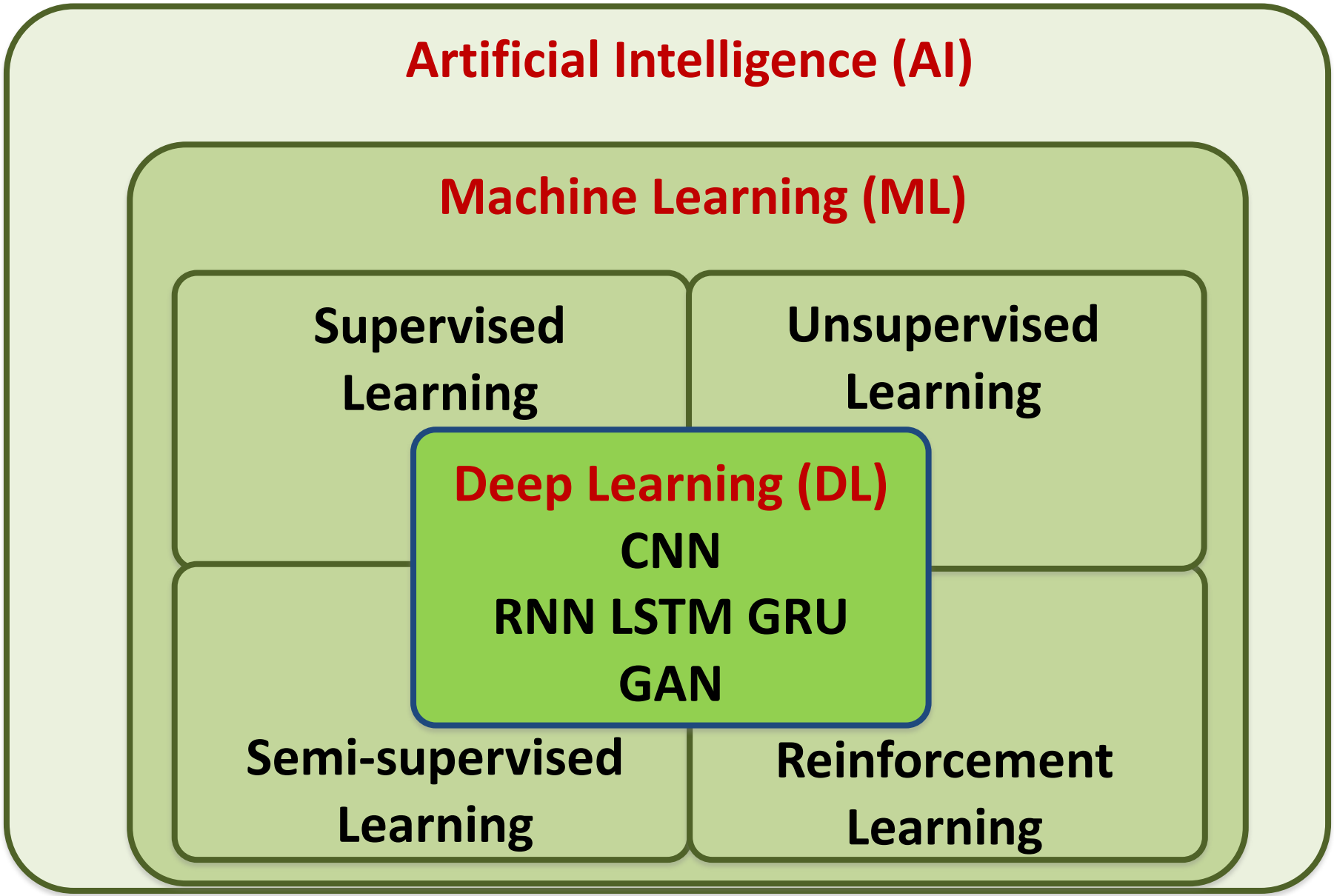
Artificial Intelligence
Machine Learning & Deep Learning



Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

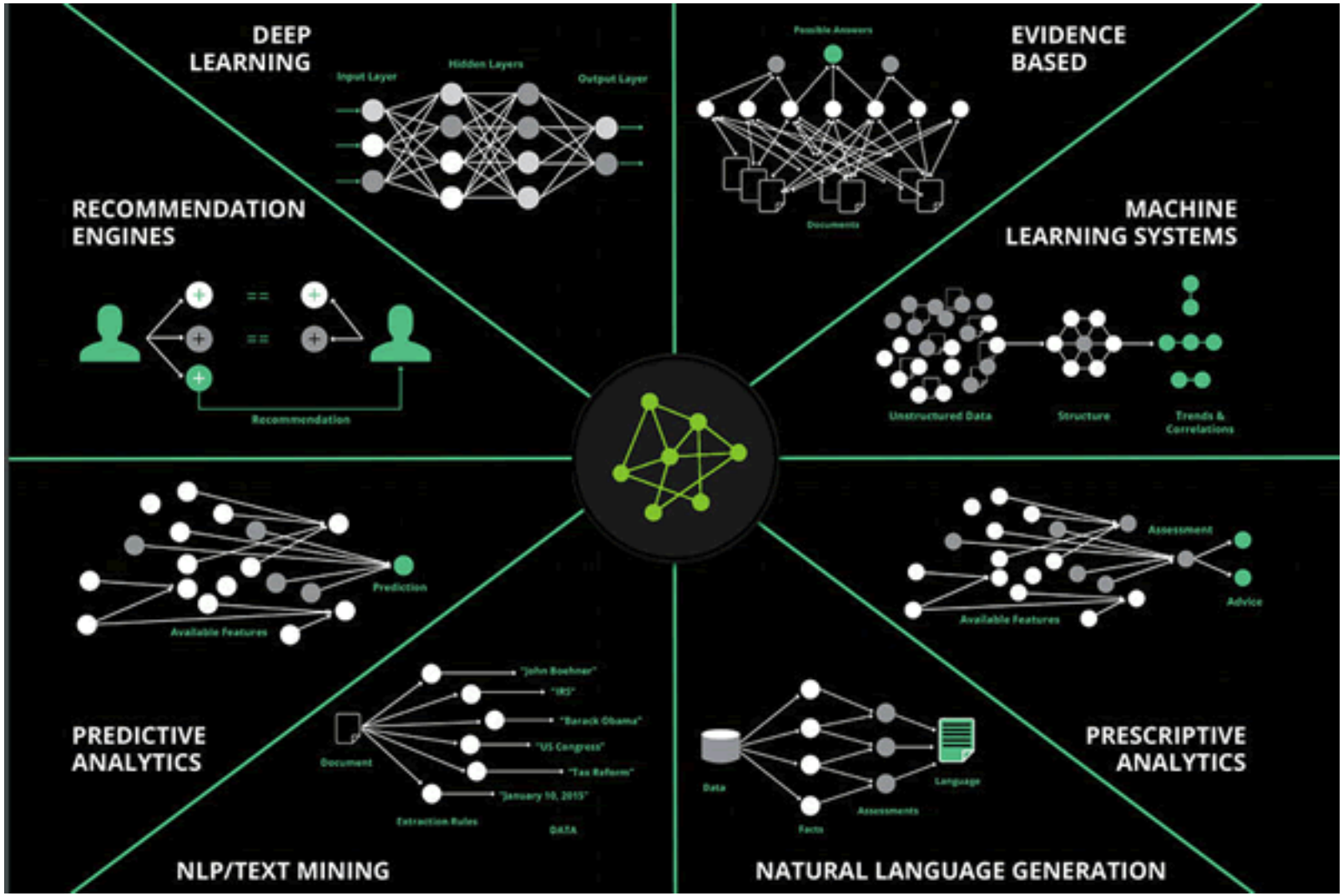
Source: https://blogs.nvidia.com/blog/2016/07/29/whats-difference-artificial-intelligence-machine-learning-deep-learning-ai/

AI, ML, DL



Source: https://leonardoaraujosantos.gitbooks.io/artificial-inteligence/content/deep_learning.html

Artificial Intelligence (AI) is many things

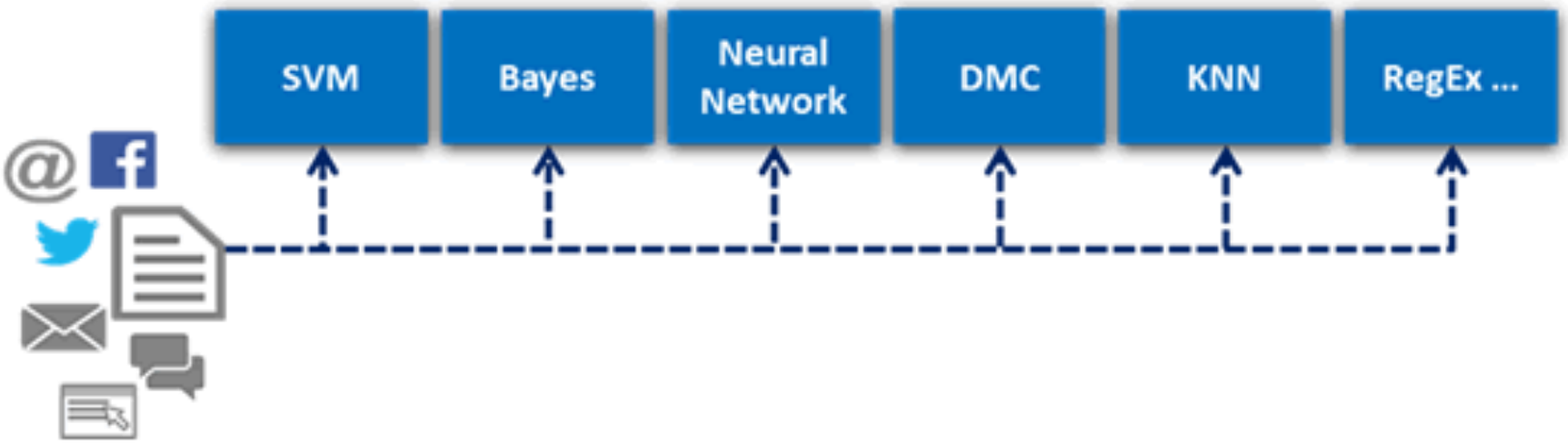


Ecosystem of AI

Source: https://www.i-scoop.eu/artificial-intelligence-cognitive-computing/

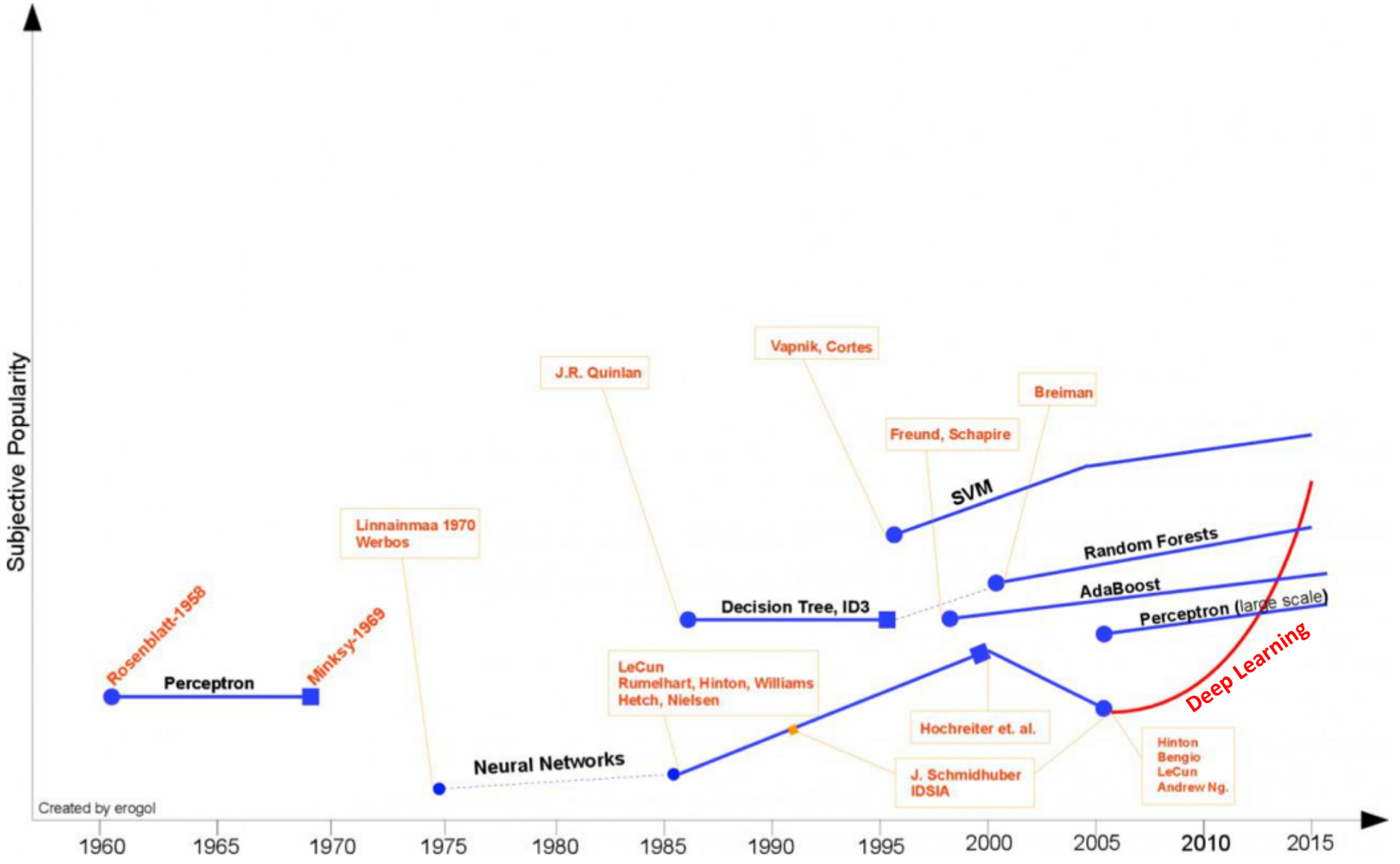
Artificial Intelligence (AI)

Intelligent Document Recognition algorithms



Source: https://www.i-scoop.eu/artificial-intelligence-cognitive-computing/

Deep Learning Evolution



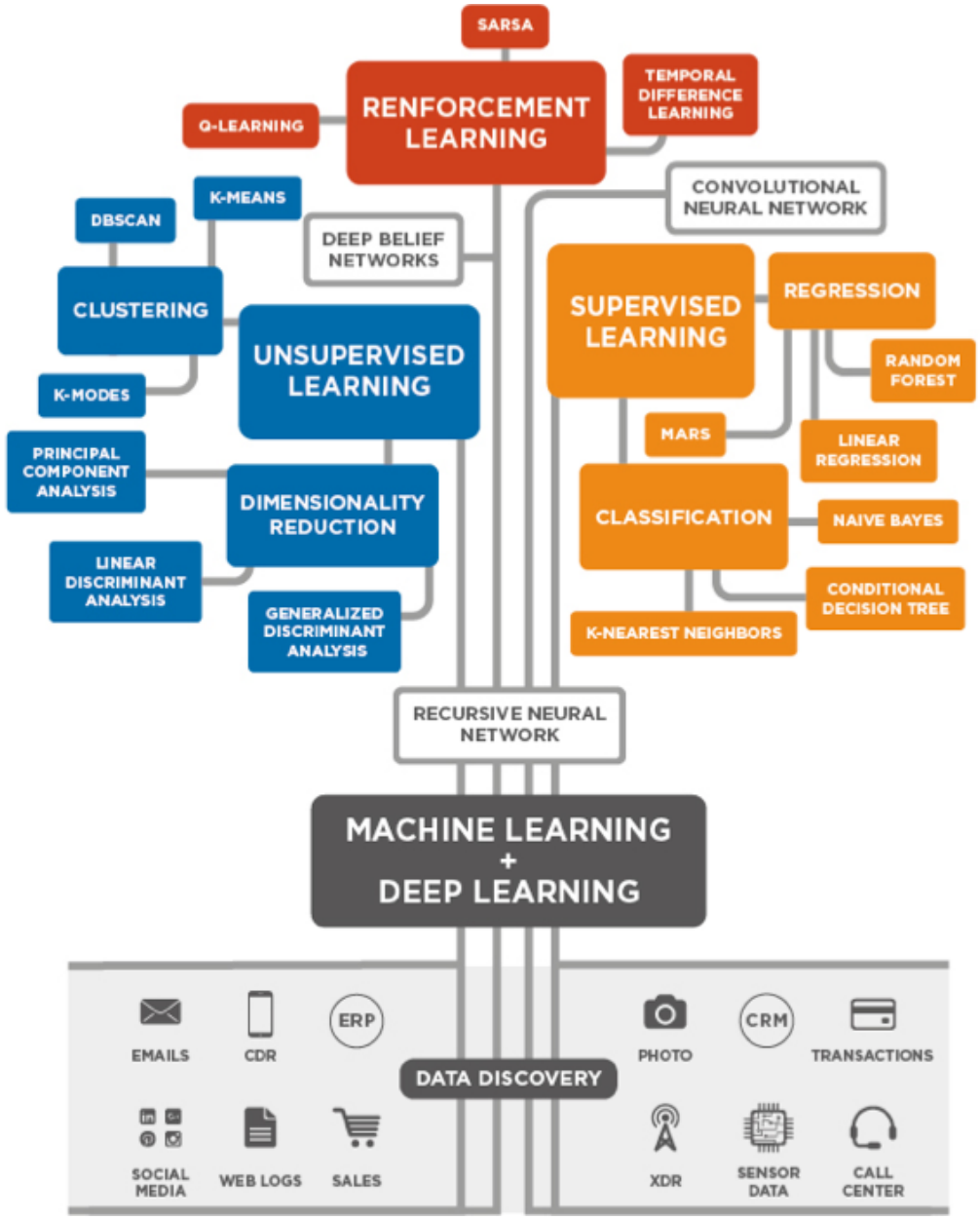
Source: http://www.erogol.com/brief-history-machine-learning/

Machine Learning Models

- Deep Learning
- Kernel
- Association rules
- Ensemble
- Decision tree
- Dimensionality reduction
- Clustering
- Regression Analysis
- Bayesian
- Instance based

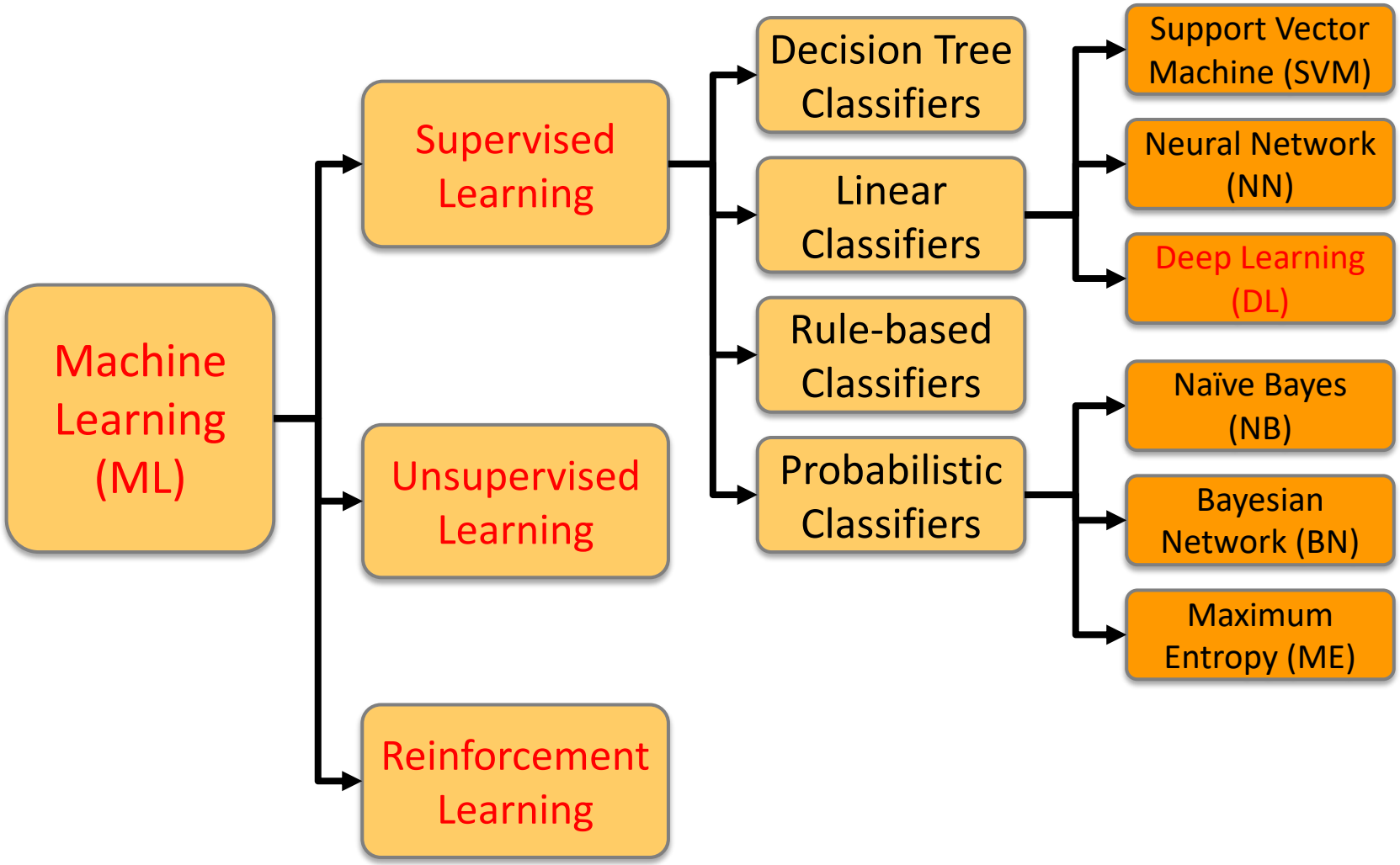
Source: Sunila Gollapudi (2016), Practical Machine Learning, Packt Publishing

3 Machine Learning Algorithms



Source: Enrico Galimberti, http://blogs.teradata.com/data-points/tree-machine-learning-algorithms/

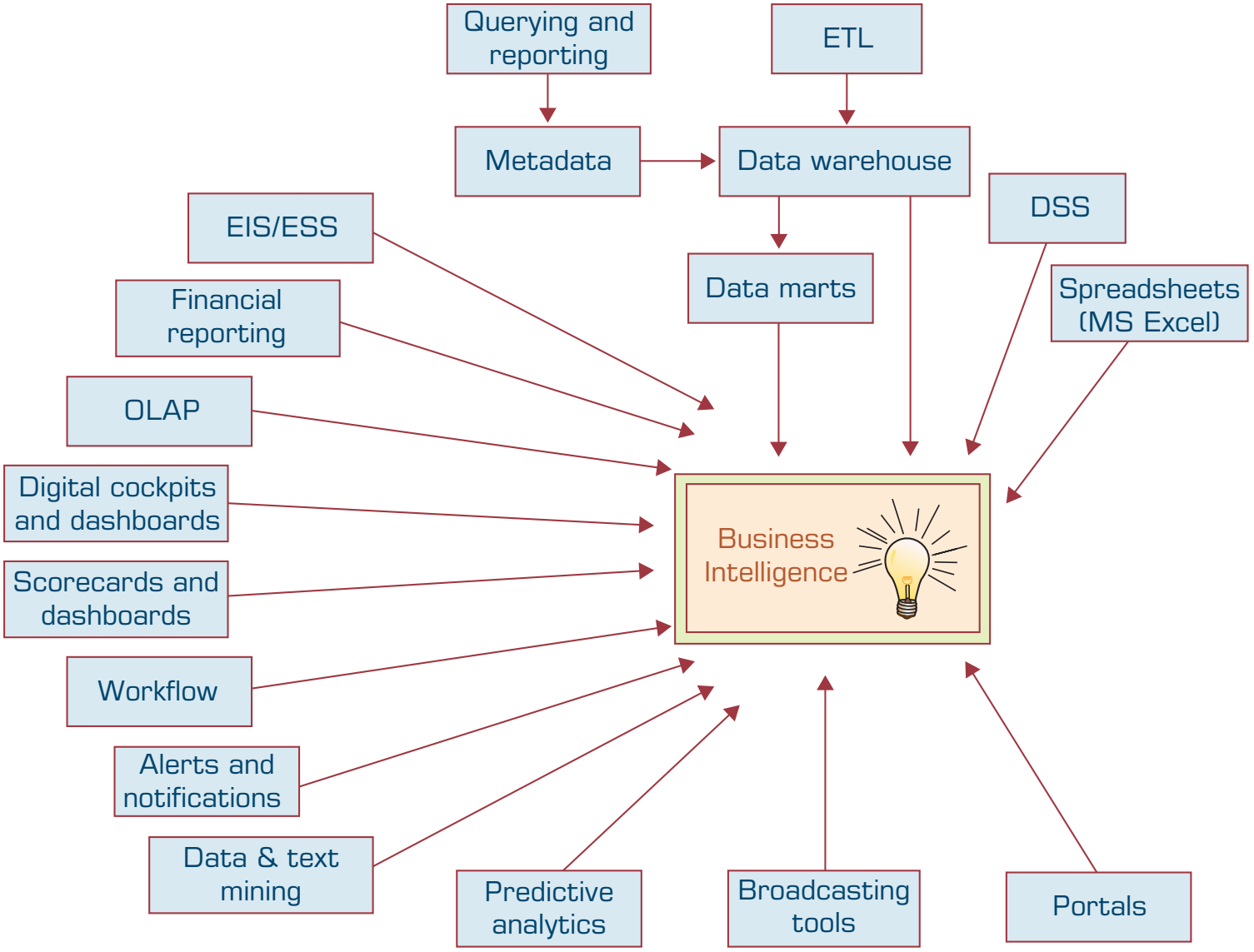
Machine Learning (ML) / Deep Learning (DL)



Source: Jesus Serrano-Guerrero, Jose A. Olivas, Francisco P. Romero, and Enrique Herrera-Viedma (2015), "Sentiment analysis: A review and comparative analysis of web services," Information Sciences, 311, pp. 18-38.

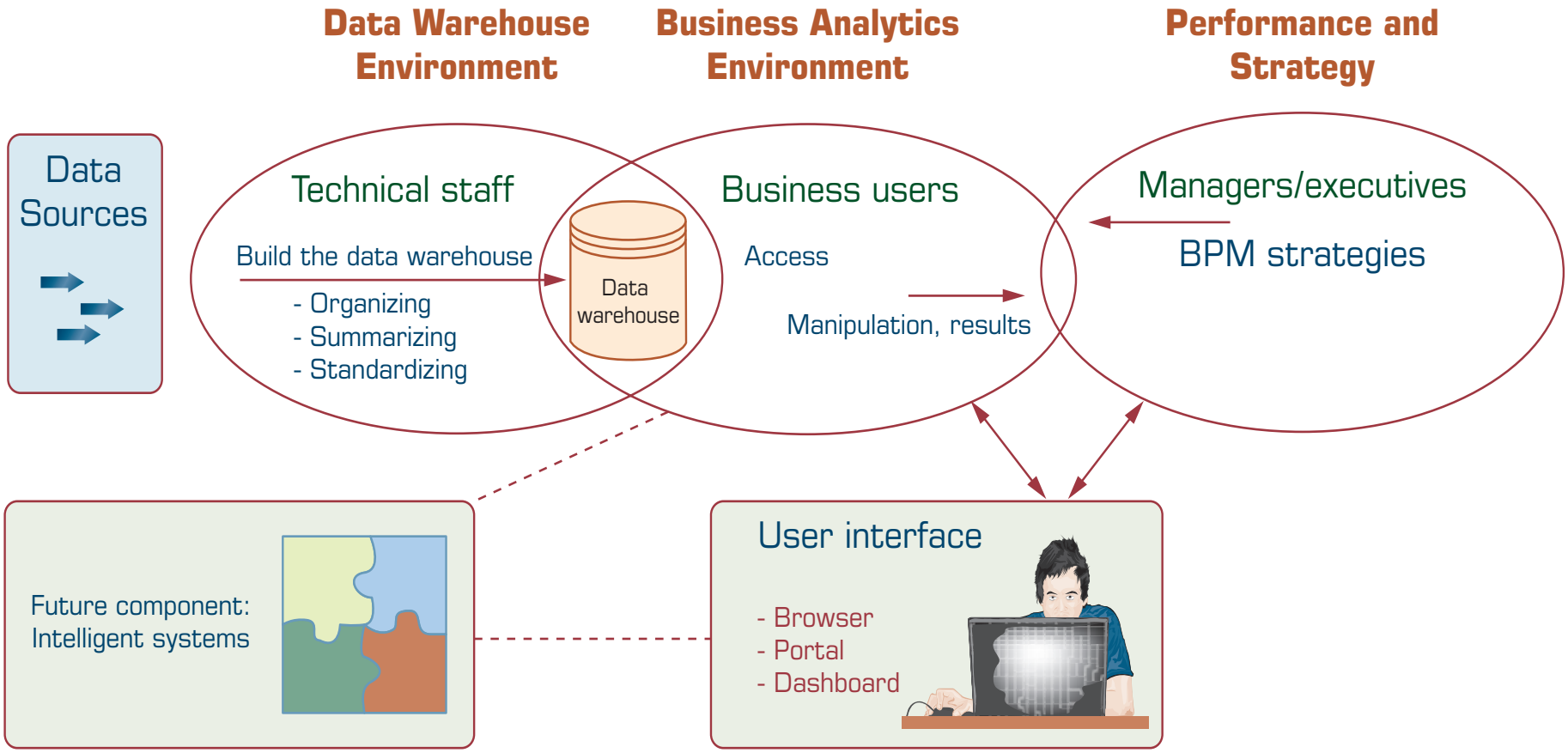
Big Data

Evolution of Business Intelligence (BI)



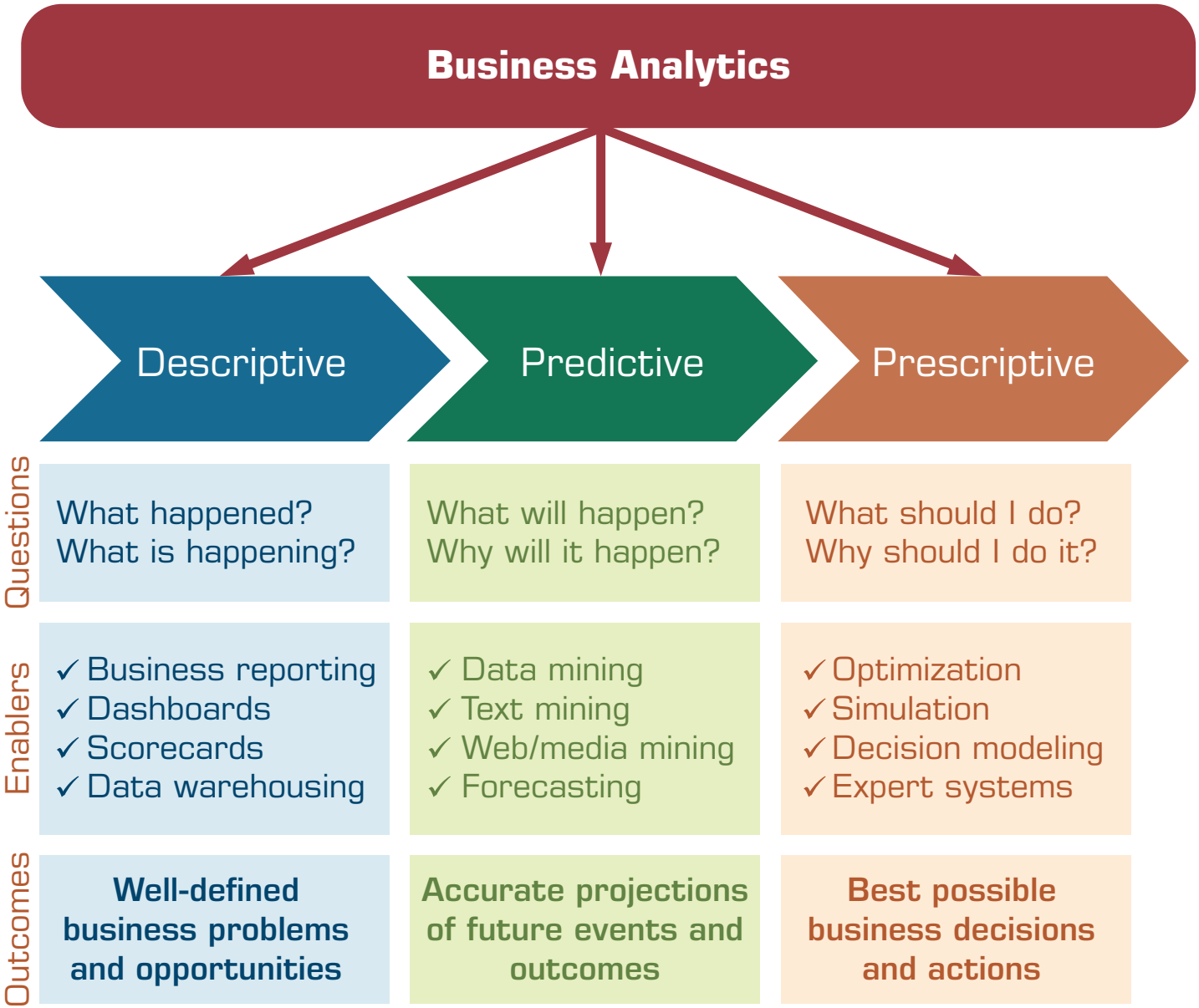
Source: Ramesh Sharda, Dursun Delen, and Efraim Turban (2017),
Business Intelligence, Analytics, and Data Science: A Managerial Perspective, 4th Edition, Pearson

A High-Level Architecture of BI



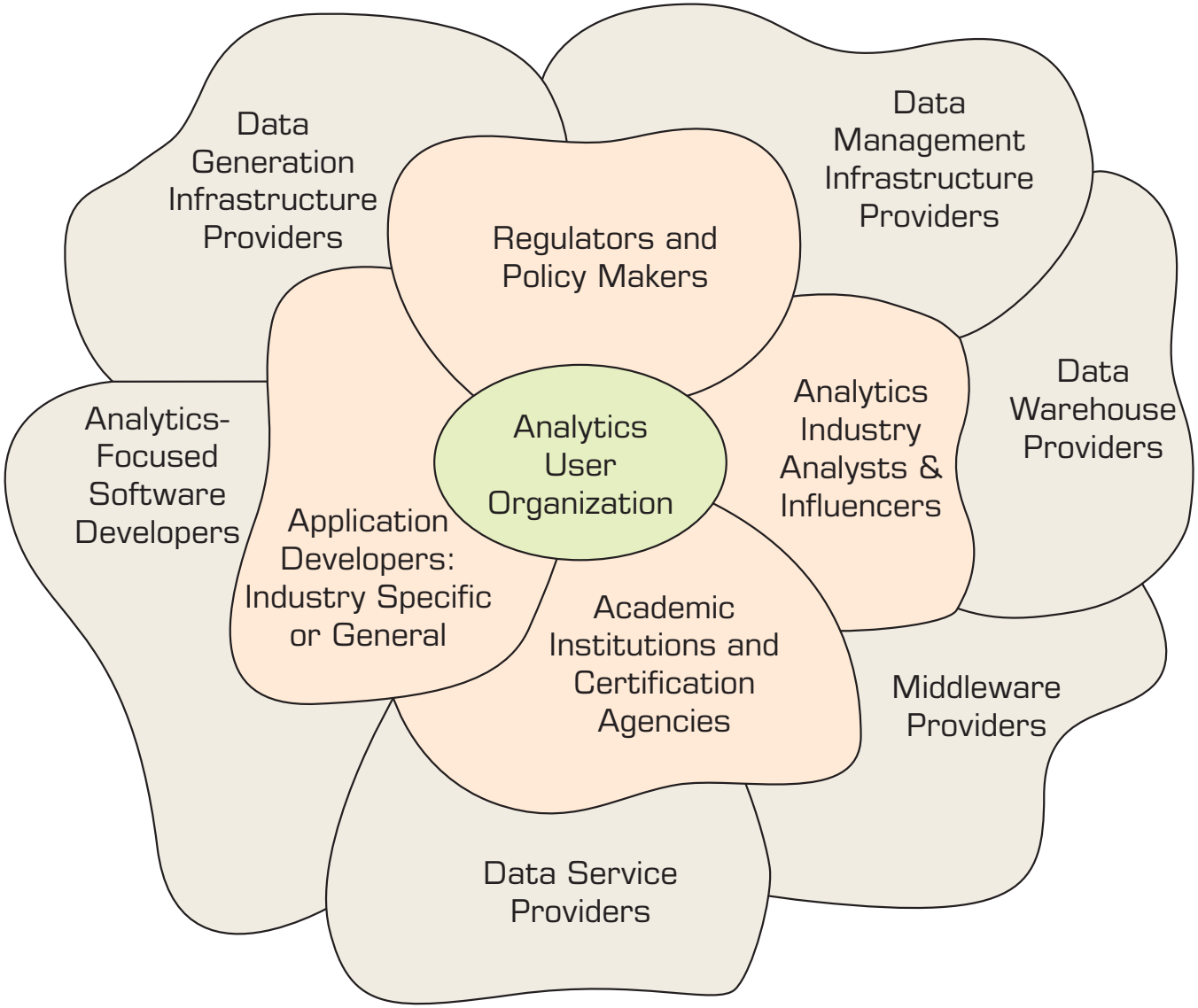
Source: Ramesh Sharda, Dursun Delen, and Efraim Turban (2017),
Business Intelligence, Analytics, and Data Science: A Managerial Perspective, 4th Edition, Pearson

Three Types of Analytics



Source: Ramesh Sharda, Dursun Delen, and Efraim Turban (2017),
Business Intelligence, Analytics, and Data Science: A Managerial Perspective, 4th Edition, Pearson

Analytics Ecosystem

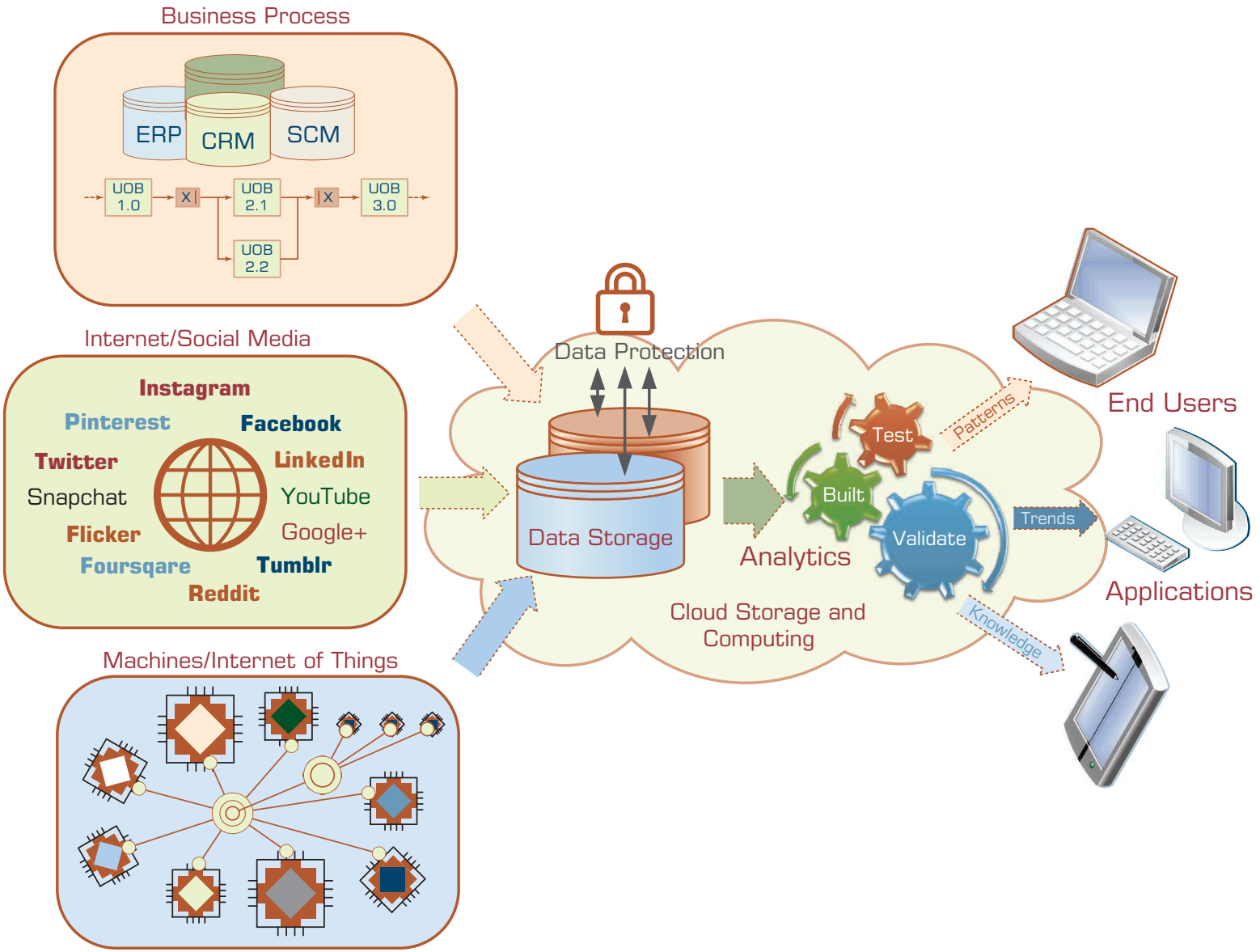


Source: Ramesh Sharda, Dursun Delen, and Efraim Turban (2017),
Business Intelligence, Analytics, and Data Science: A Managerial Perspective, 4th Edition, Pearson

Job Titles of Analytics

Source: Ramesh Sharda, Dursun Delen, and Efraim Turban (2017),
Business Intelligence, Analytics, and Data Science: A Managerial Perspective, 4th Edition, Pearson

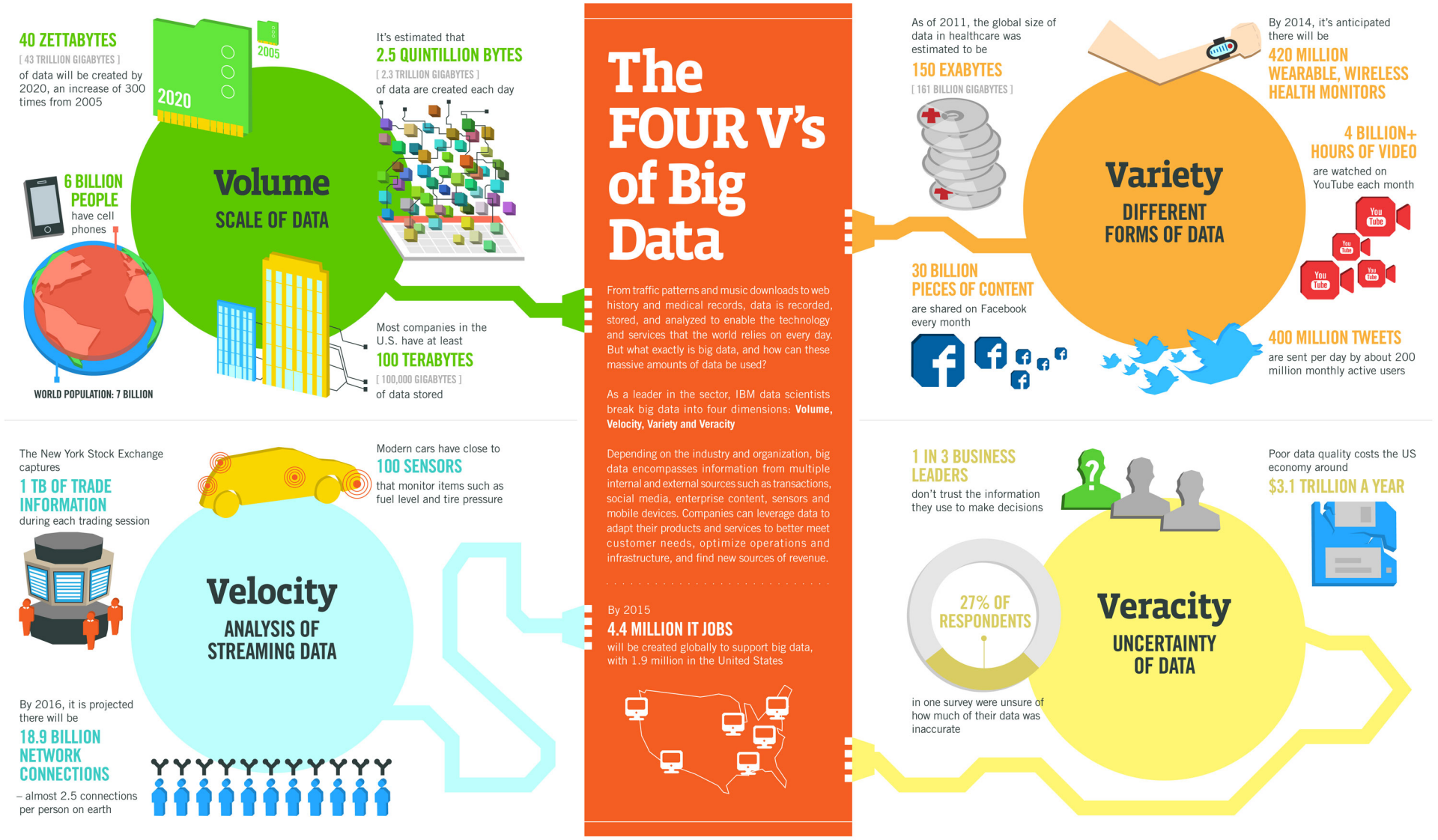
A Data to Knowledge Continuum



Source: Ramesh Sharda, Dursun Delen, and Efraim Turban (2017),
Business Intelligence, Analytics, and Data Science: A Managerial Perspective, 4th Edition, Pearson

Big Data Analytics and Data Mining

Big Data 4 V



Sources: McKinsey Global Institute, Twitter, Cisco, Gartner, EMC, SAS, IBM, MEPTEC, QAS

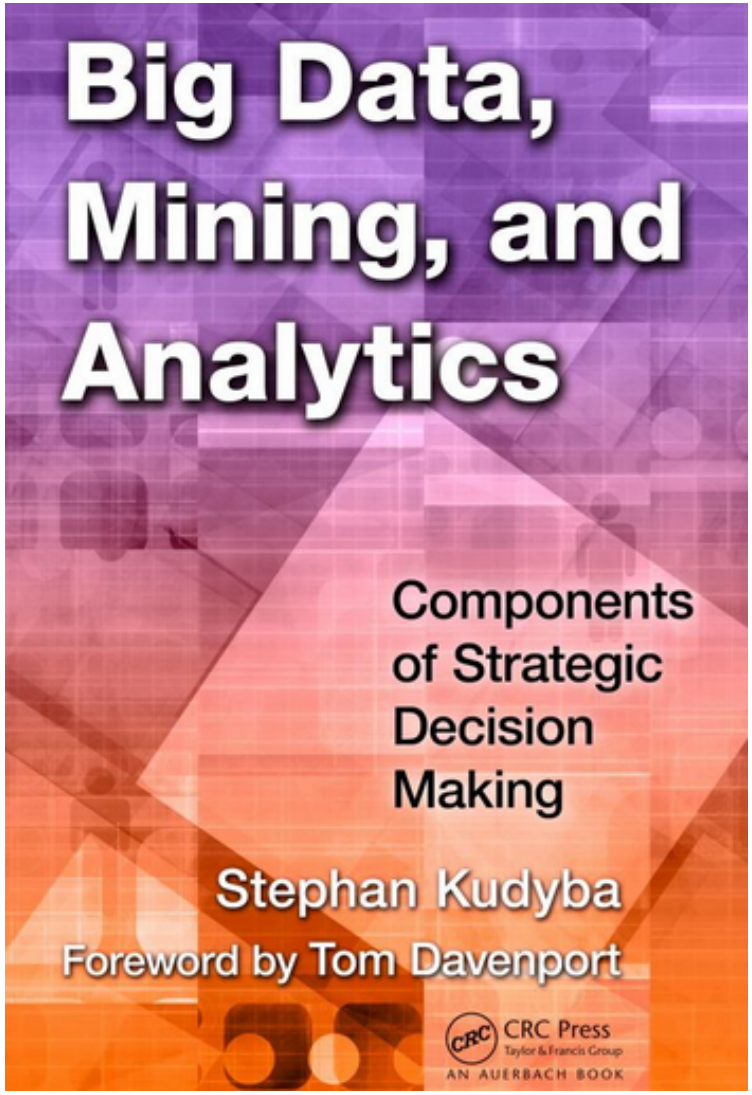
IBM

Source: https://www-01.ibm.com/software/data/bigdata/

Value

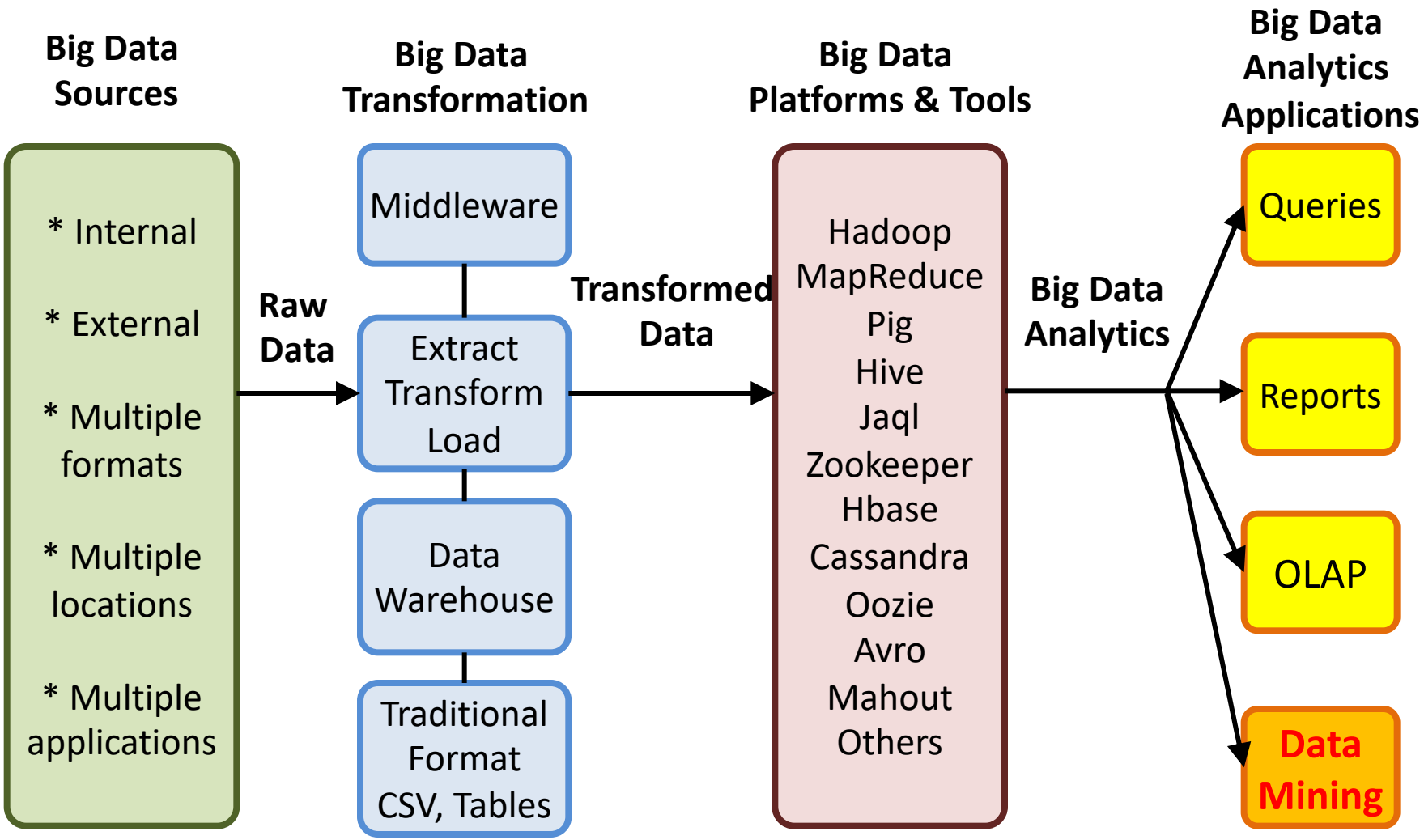
Stephan Kudyba (2014),

Big Data, Mining, and Analytics: Components of Strategic Decision Making, Auerbach Publications



Source: http://www.amazon.com/gp/product/1466568704

Architecture of Big Data Analytics



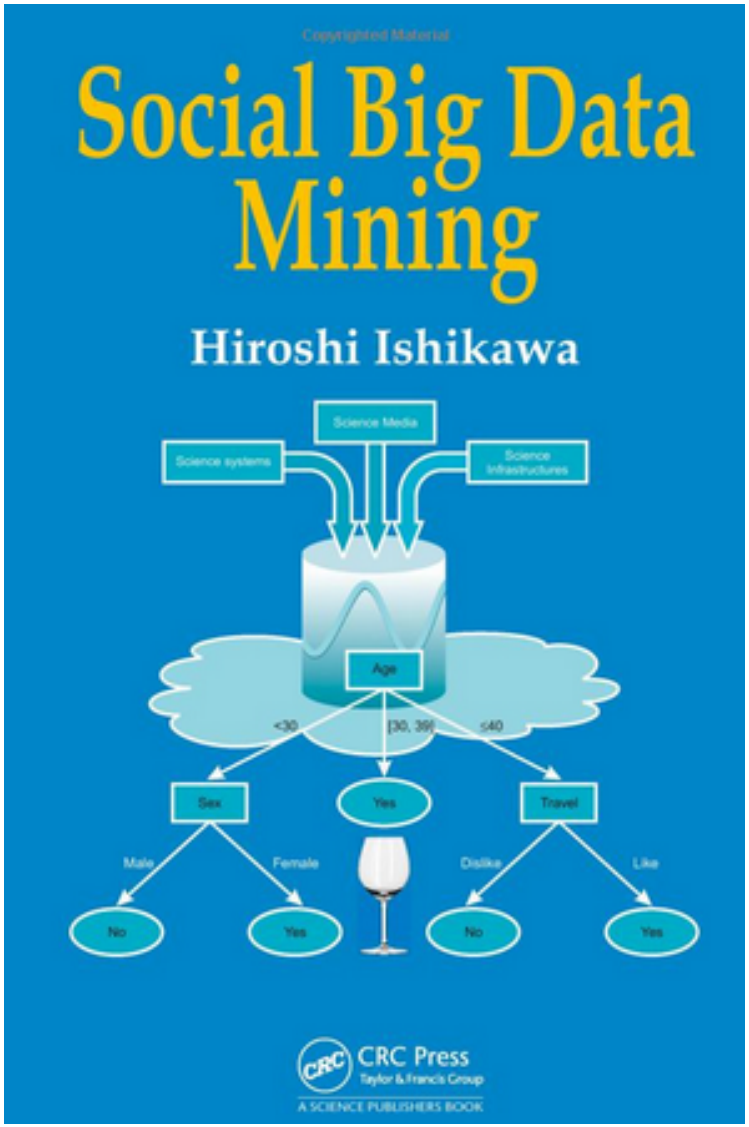
Source: Stephan Kudyba (2014), Big Data, Mining, and Analytics: Components of Strategic Decision Making, Auerbach Publications

Architecture of Big Data Analytics

Source: Stephan Kudyba (2014), Big Data, Mining, and Analytics: Components of Strategic Decision Making, Auerbach Publications

Social Big Data Mining

(Hiroshi Ishikawa, 2015)



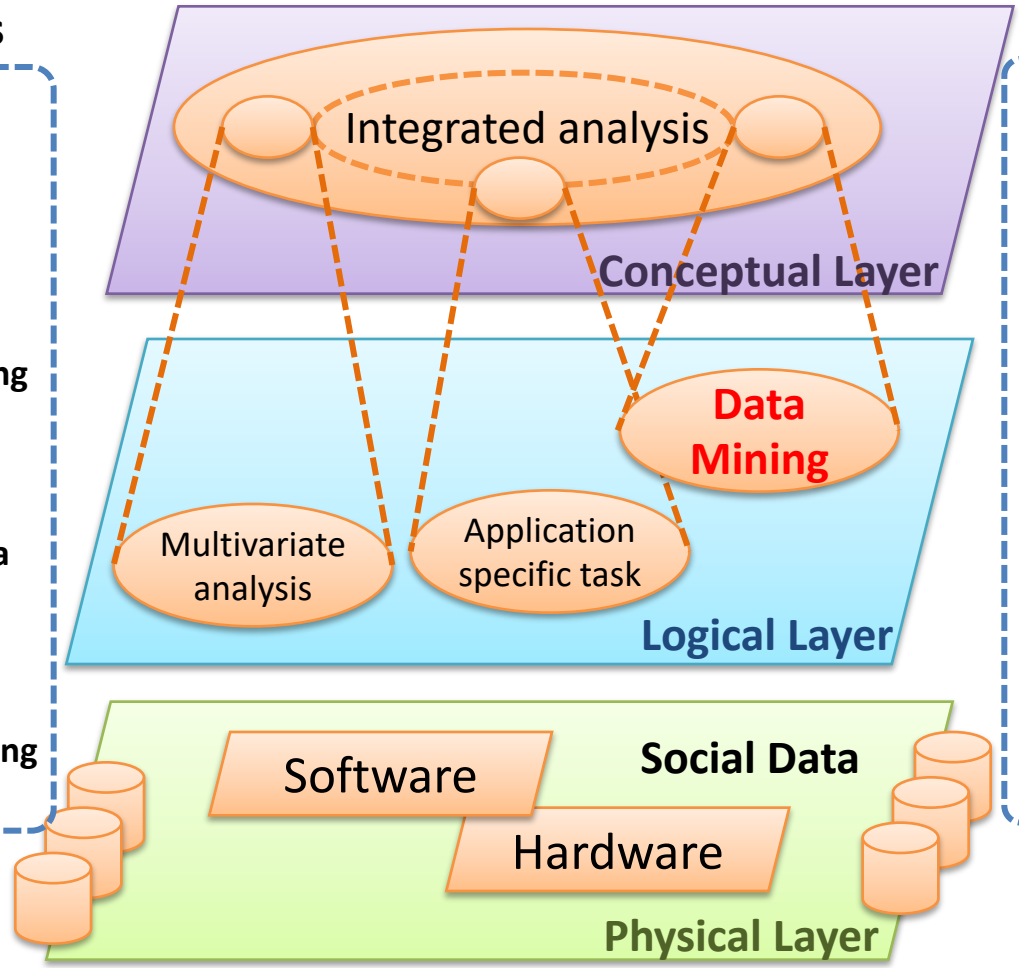
Source: http://www.amazon.com/Social-Data-Mining-Hiroshi-Ishikawa/dp/149871093X

Architecture for Social Big Data Mining

(Hiroshi Ishikawa, 2015)

Enabling Technologies

- Integrated analysis model
- Natural Language Processing
- Information Extraction
- Anomaly Detection
- Discovery of relationships among heterogeneous data
- Large-scale visualization
- Parallel distrusted processing

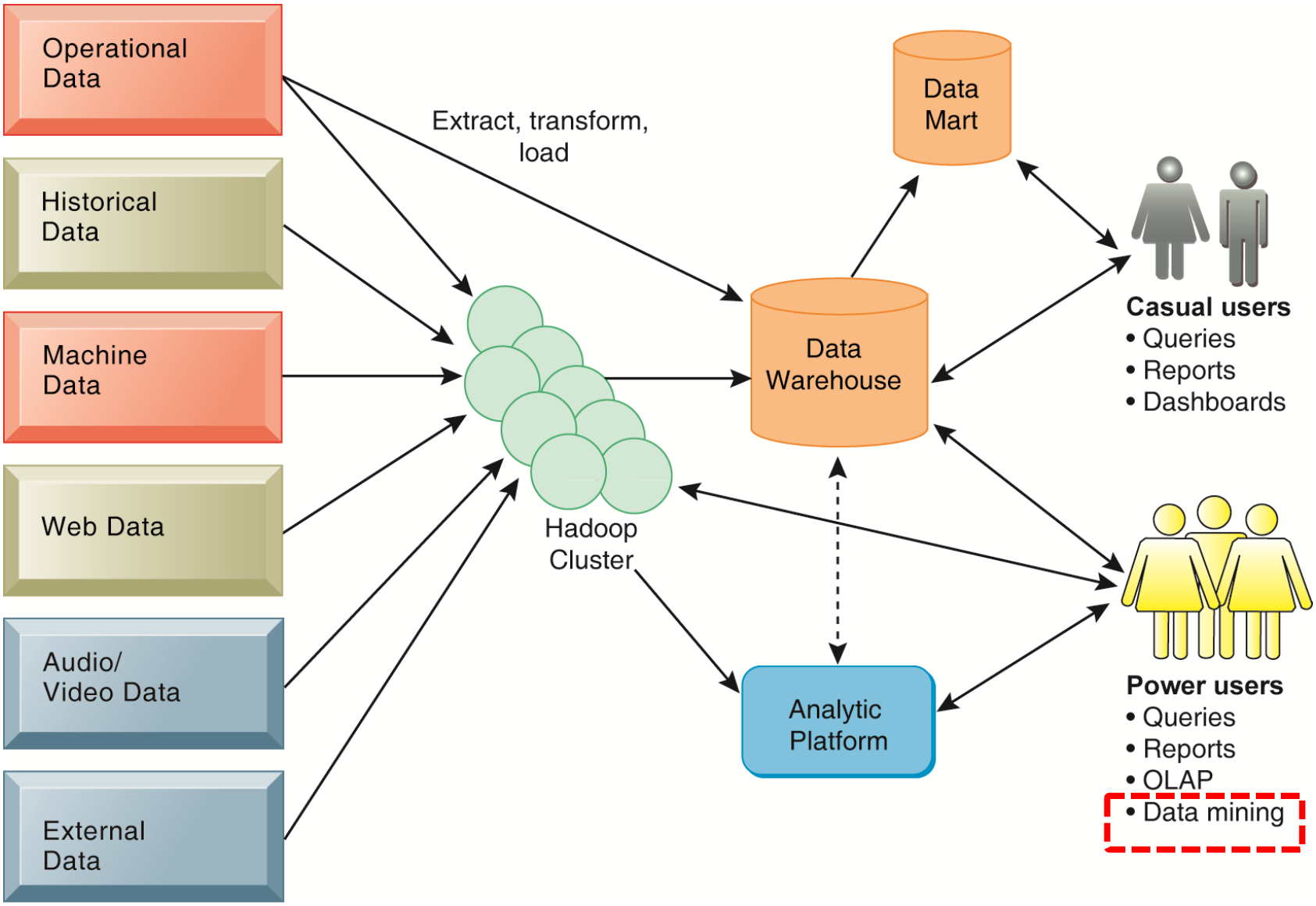


Analysts

- Model Construction
- Explanation by Model
- Construction and confirmation of individual hypothesis
- Description and execution of application-specific task

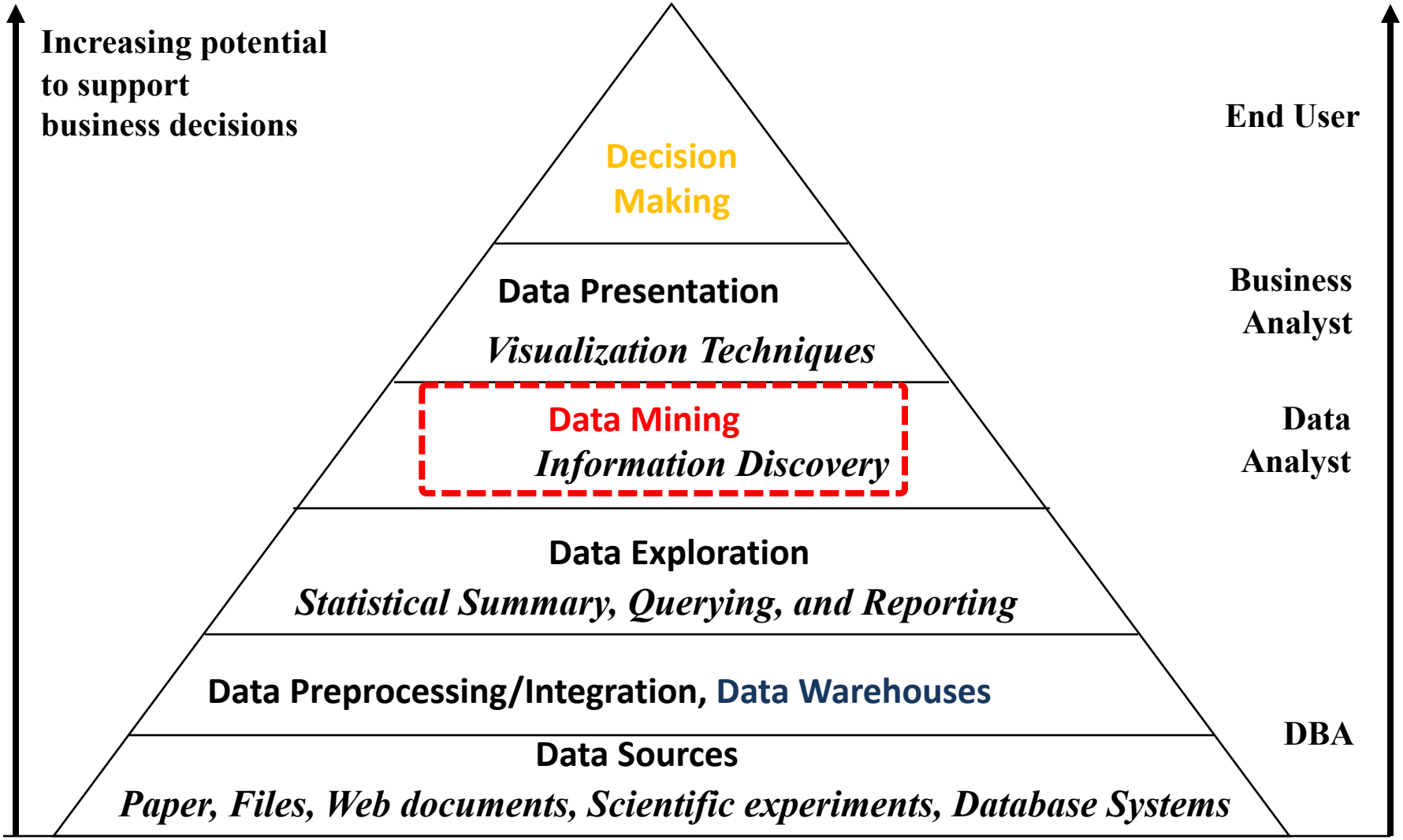
Source: Hiroshi Ishikawa (2015), Social Big Data Mining, CRC Press

Business Intelligence (BI) Infrastructure



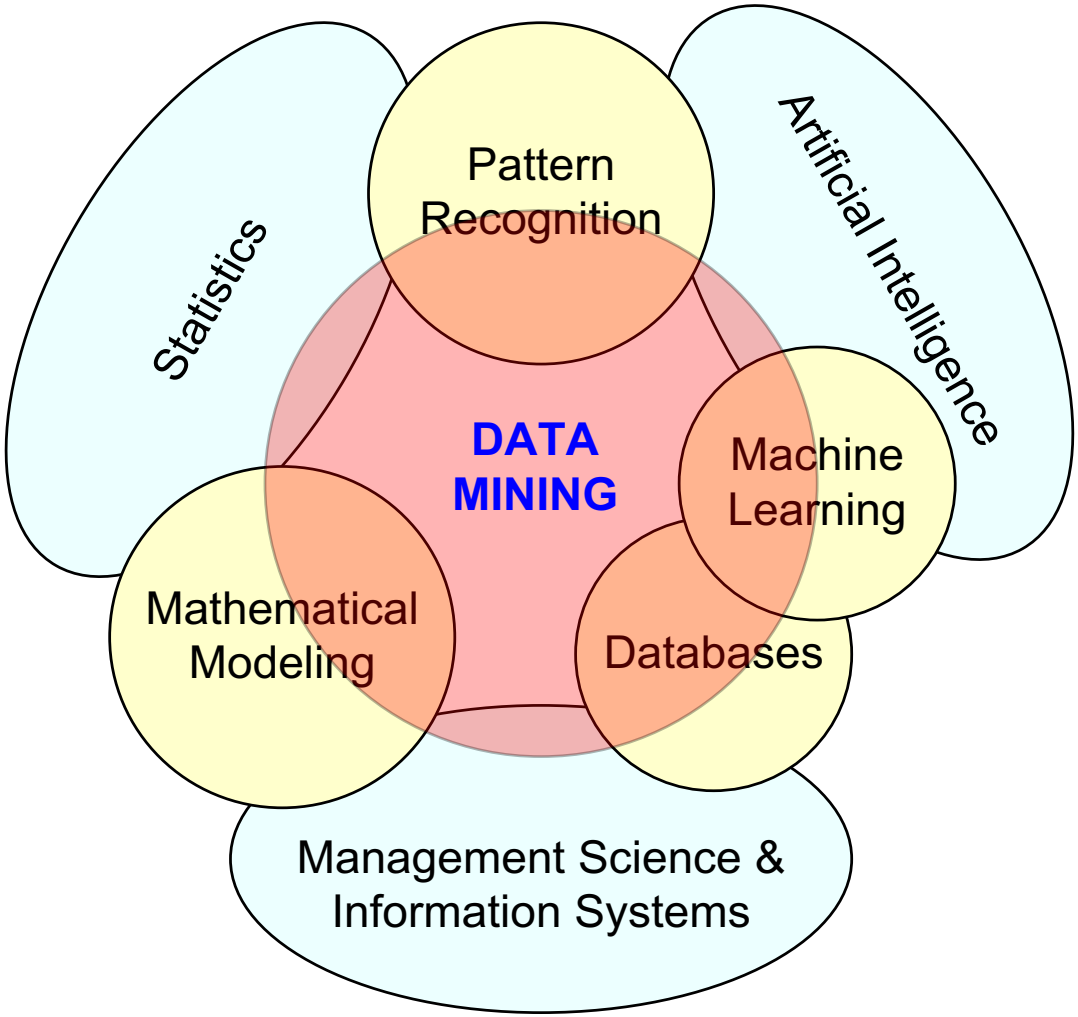
Source: Kenneth C. Laudon & Jane P. Laudon (2014), Management Information Systems: Managing the Digital Firm, Thirteenth Edition, Pearson.

Business Intelligence and Data Mining



Source: Jiawei Han and Micheline Kamber (2006), Data Mining: Concepts and Techniques, Second Edition, Elsevier

Data Mining at the Intersection of Many Disciplines



Source: Turban et al. (2011), Decision Support and Business Intelligence Systems

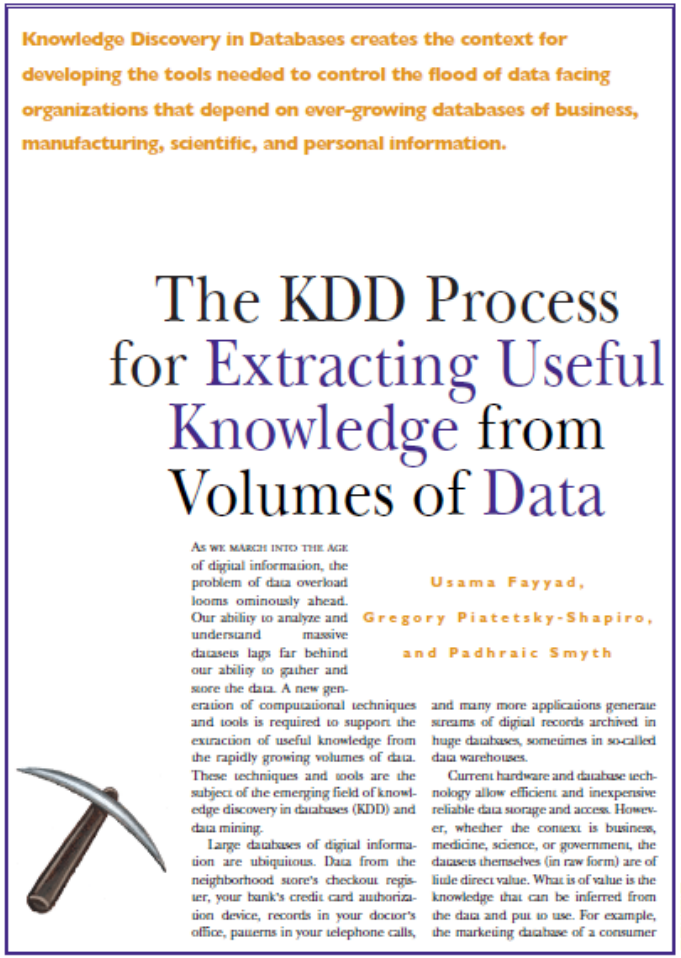
Data Mining:

Core Analytics Process

The KDD Process for Extracting Useful Knowledge from Volumes of Data

Source: Fayyad, U., Piatetsky-Shapiro, G., & Smyth, P. (1996). The KDD Process for Extracting Useful Knowledge from Volumes of Data. Communications of the ACM, 39(11), 27-34.

Fayyad, U., Piatetsky-Shapiro, G., & Smyth, P. (1996).
The KDD Process for
Extracting Useful Knowledge
from Volumes of Data.
Communications of the ACM, 39(11), 27-34.



Knowledge Discovery in Databases creates the context for developing the tools needed to control the flood of data facing organizations that depend on ever-growing databases of business, manufacturing, scientific, and personal information.

The KDD Process for Extracting Useful Knowledge from Volumes of Data

Usama Fayyad,
Gregory Piatetsky-Shapiro,
and Padhraic Smyth

As we march into the age of digital information, the problem of data overload looms ominously ahead. Our ability to analyze and understand massive datasets lags far behind our ability to gather and store the data. A new generation of computational techniques and tools is required to support the extraction of useful knowledge from the rapidly growing volumes of data. These techniques and tools are the subject of the emerging field of knowledge discovery in databases (KDD) and data mining.

Large databases of digital information are ubiquitous. Data from the neighborhood store's checkout register, your bank's credit card authorization device, records in your doctor's office, patterns in your telephone calls, and many more applications generate streams of digital records archived in huge databases, sometimes in so-called data warehouses.

Current hardware and database technology allow efficient and inexpensive reliable data storage and access. However, whether the context is business, medicine, science, or government, the datasets themselves (in raw form) are of little direct value. What is of value is the knowledge that can be inferred from the data and put to use. For example, the marketing database of a consumer

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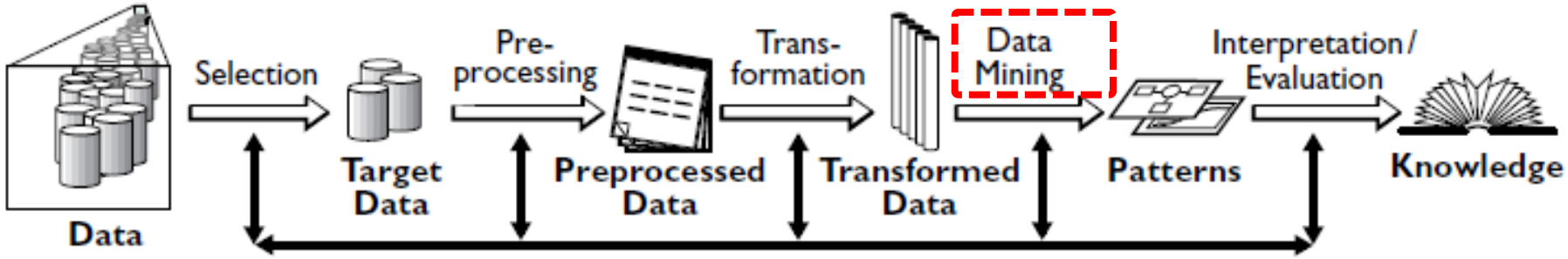
Data Mining

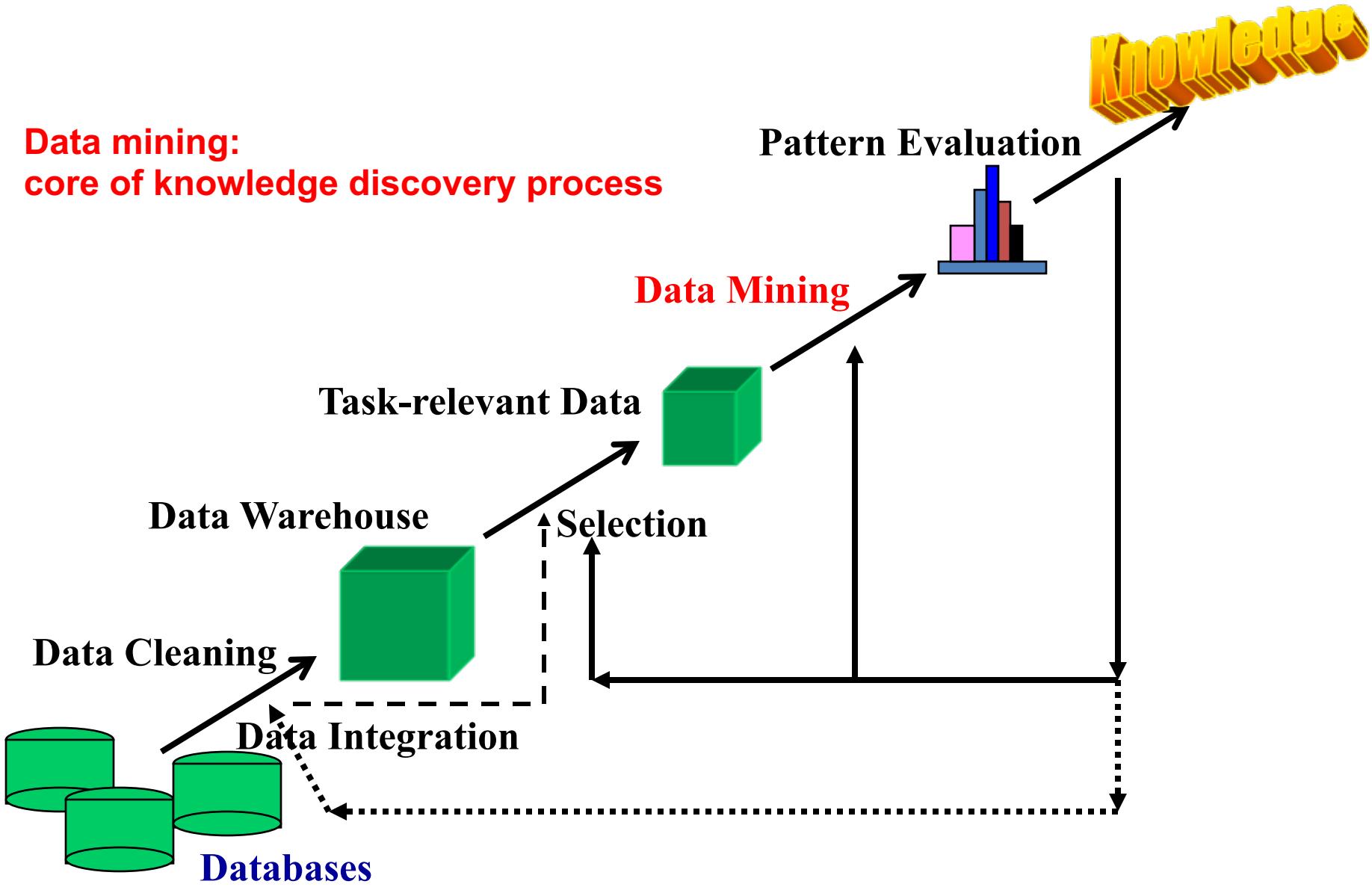
Knowledge Discovery in Databases (KDD) Process

(Fayyad et al., 1996)



Source: Fayyad, U., Piatetsky-Shapiro, G., & Smyth, P. (1996). The KDD Process for Extracting Useful Knowledge from Volumes of Data. Communications of the ACM, 39(11), 27-34.

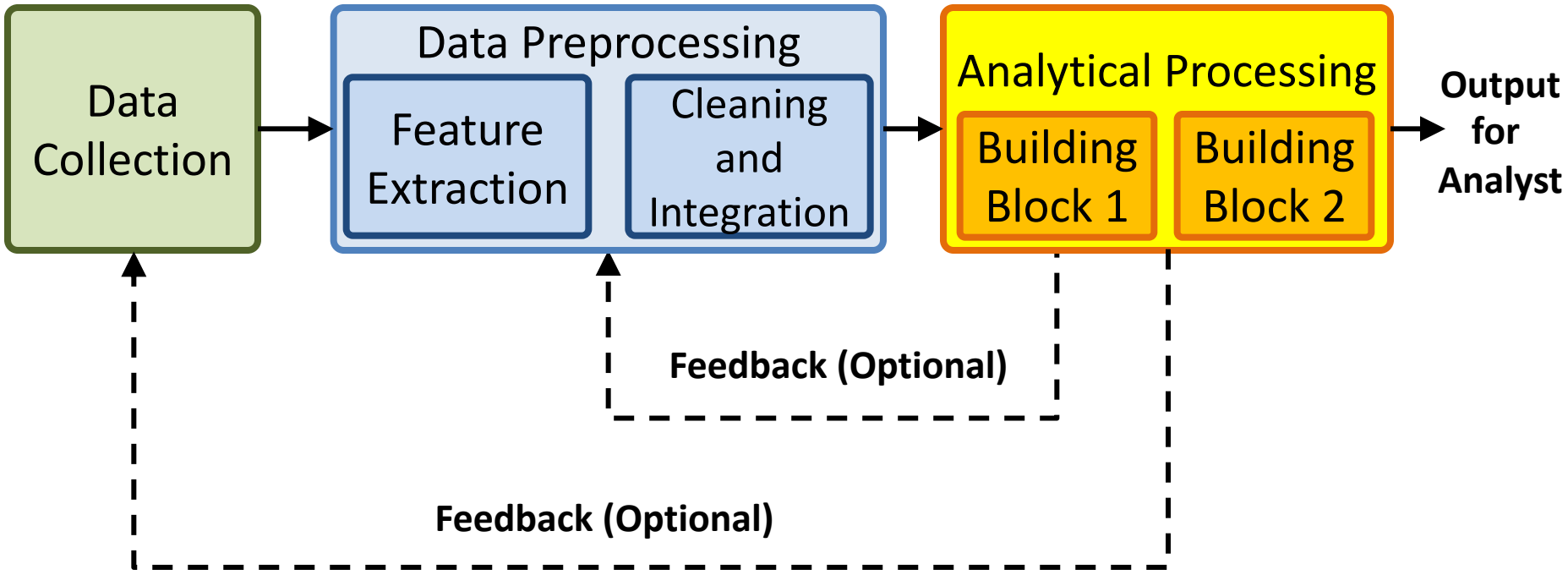
Knowledge Discovery (KDD) Process



Source: Han & Kamber (2006)

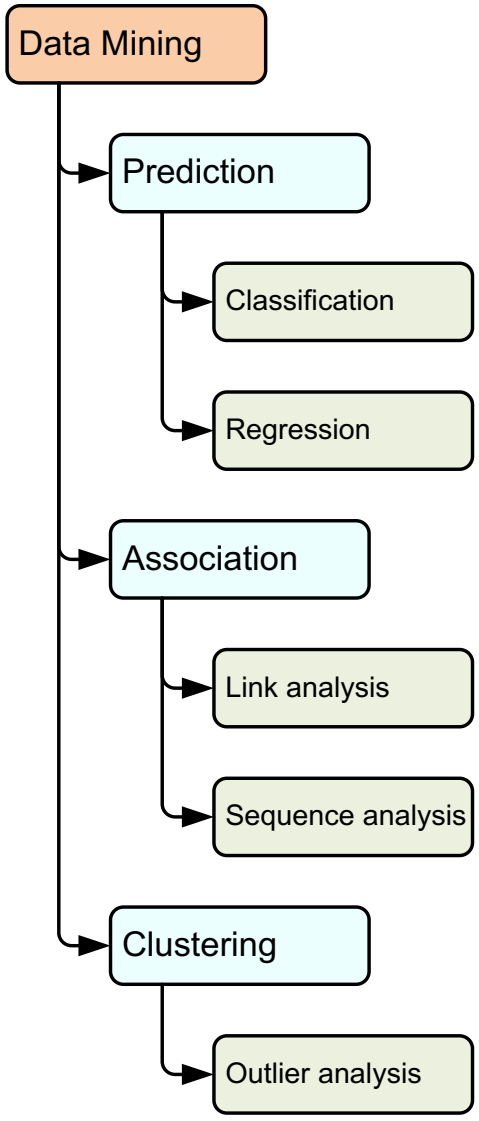
Data Mining Processing Pipeline

(Charu Aggarwal, 2015)



Source: Charu Aggarwal (2015), Data Mining: The Textbook Hardcover, Springer

A Taxonomy for Data Mining Tasks



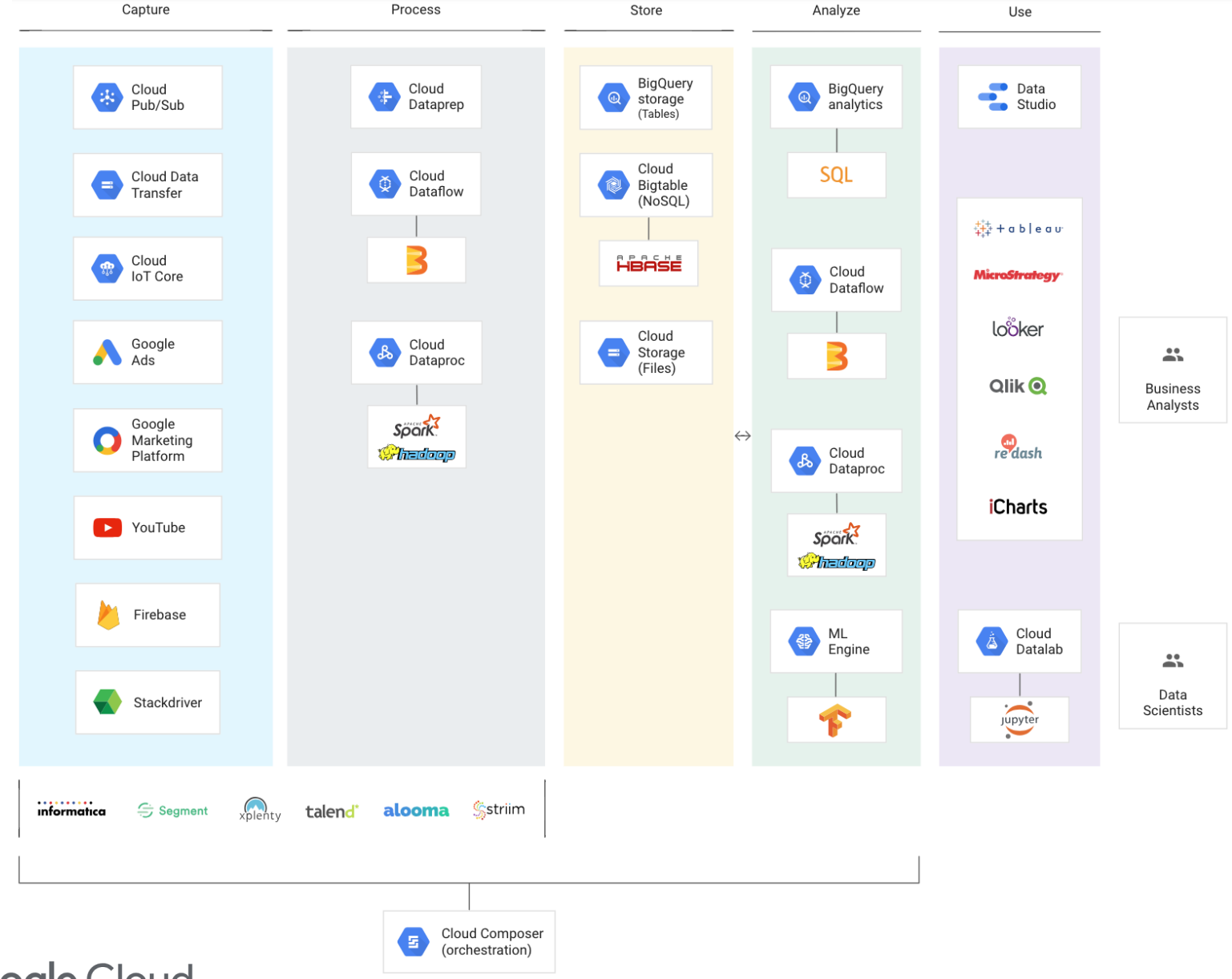
Learning Method	Popular Algorithms
Supervised	Classification and Regression Trees, ANN, SVM, Genetic Algorithms
Supervised	Decision trees, ANN/MLP, SVM, Rough sets, Genetic Algorithms
Supervised	Linear/Nonlinear Regression, Regression trees, ANN/MLP, SVM
Unsupervised	Apriory, OneR, ZeroR, Eclat
Unsupervised	Expectation Maximization, Apriory Algorithm, Graph-based Matching
Unsupervised	Apriory Algorithm, FP-Growth technique
Unsupervised	K-means, ANN/SOM
Unsupervised	K-means, Expectation Maximization (EM)

Source: Turban et al. (2011), Decision Support and Business Intelligence Systems

Cloud Computing

Google Cloud

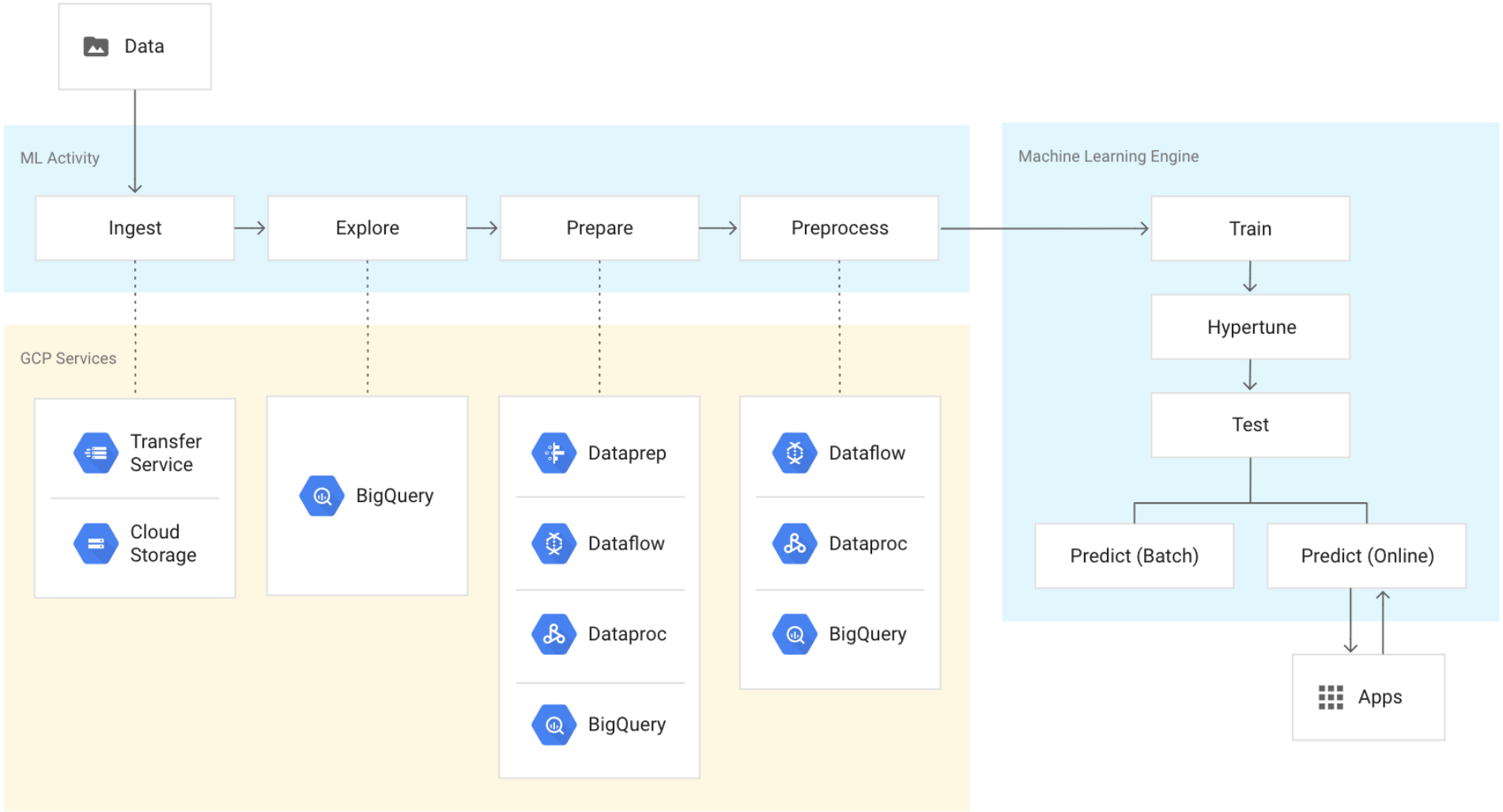
Google Cloud Big Data Analytics



Source: https://cloud.google.com/solutions/big-data/

Google Cloud

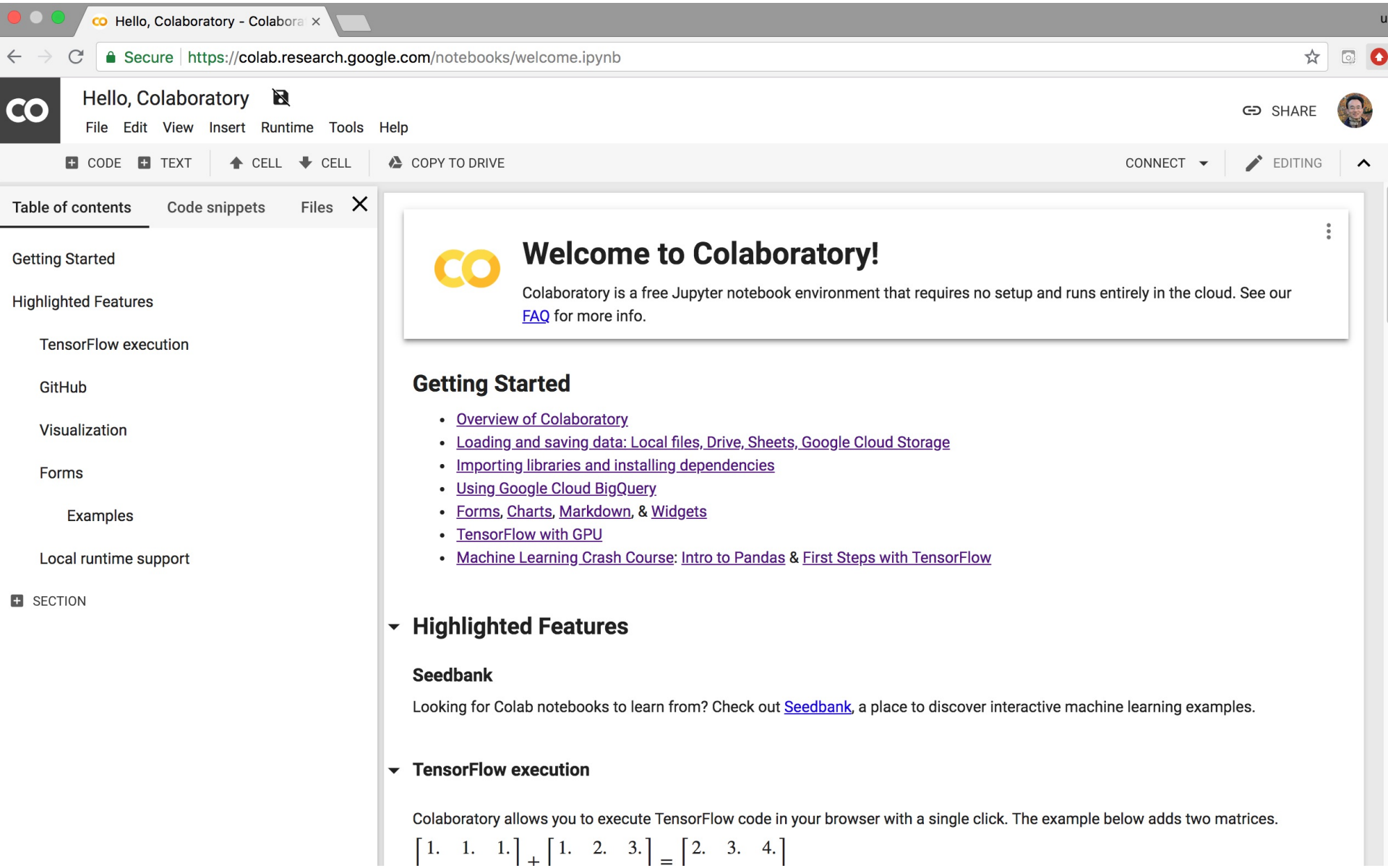
Machine learning and Cloud AI



Google Cloud

Source: https://cloud.google.com/solutions/big-data/overview/machine-learning-cloud-ai/

Google Colab

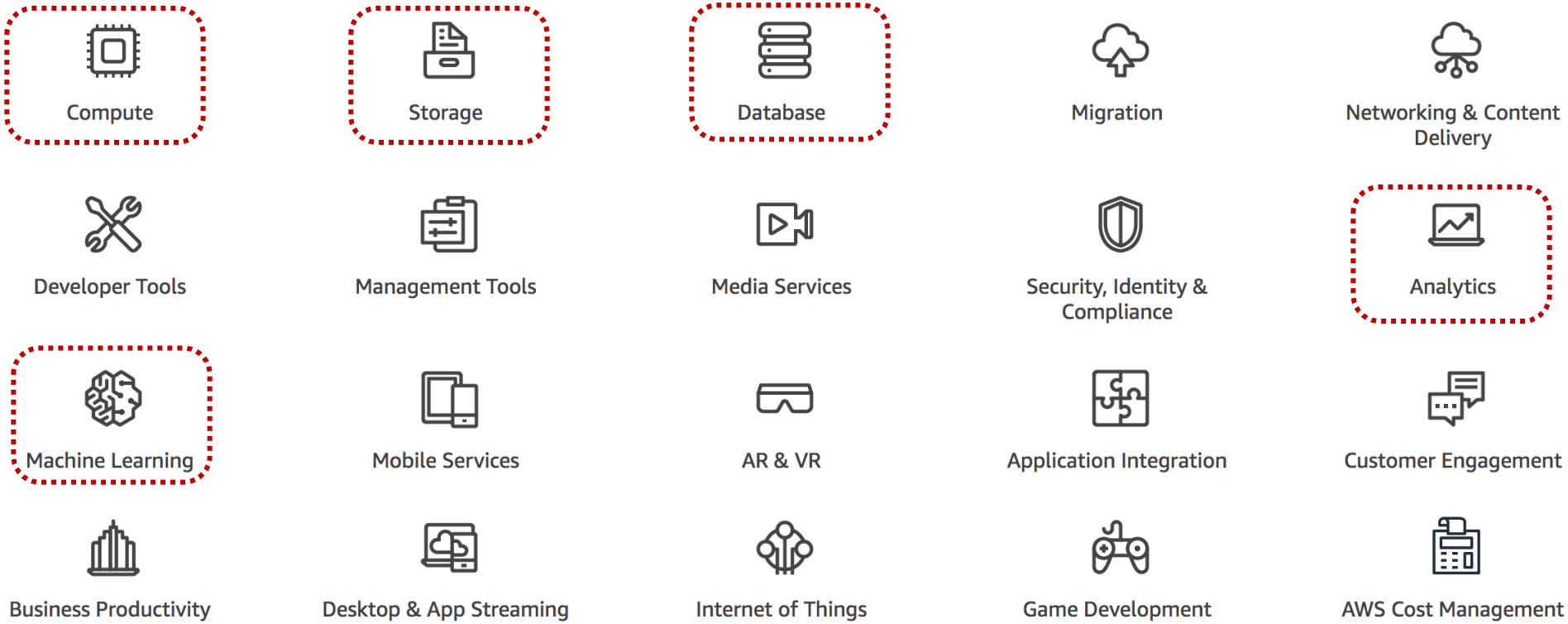


https://colab.research.google.com/notebooks/welcome.ipynb

Cloud Computing

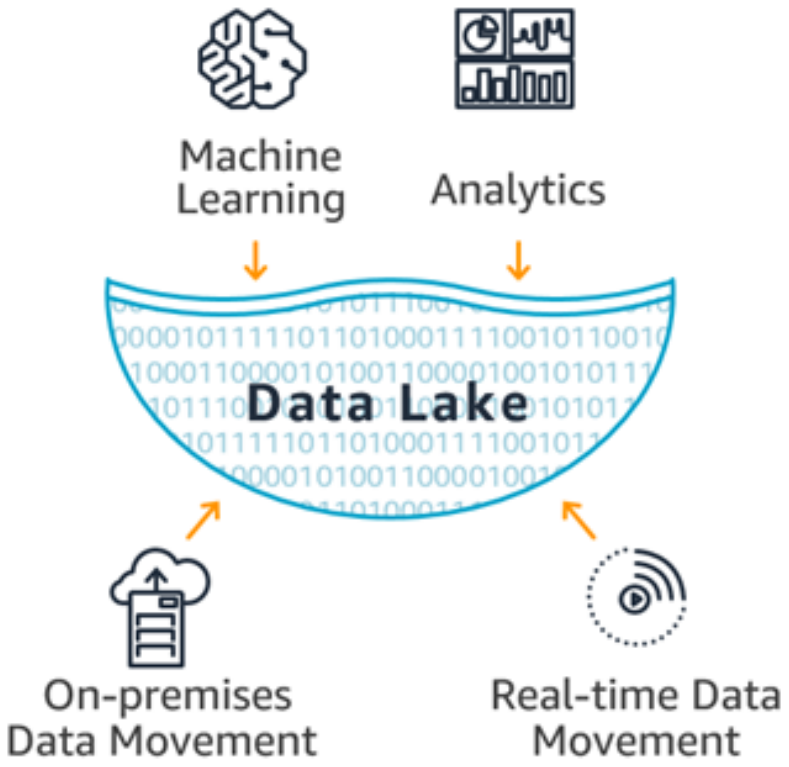
AWS

Amazon Web Services



Source: https://aws.amazon.com/

Data Lakes and Analytics on AWS



Data Movement

Import your data from on-premises, and in real-time.

Data Lake

Store any type of data securely, from gigabytes to exabytes.

Analytics

Analyze your data with a broad selection of analytic tools and engines.

Machine Learning

Forecast future outcomes, and prescribe actions.

Source: https://aws.amazon.com/big-data/datalakes-and-analytics/

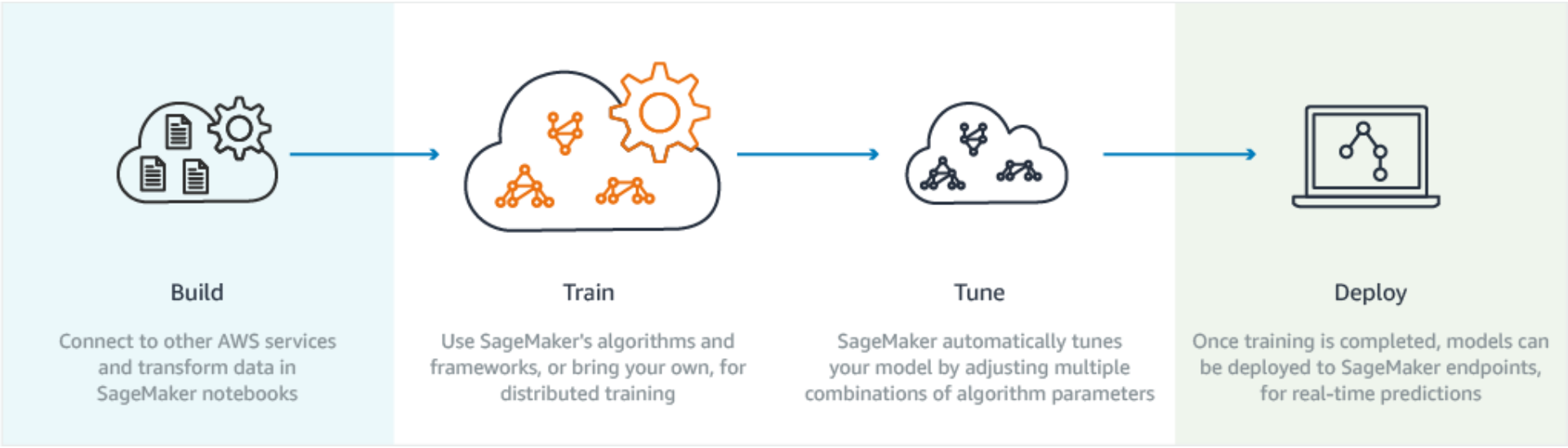
AWS Products
Analytics

- **Amazon Athena**
  - Query data in S3 using SQL
- **Amazon CloudSearch**
  - Managed search service
- **Amazon EMR**
  - Hosted Hadoop framework
- **Amazon Elasticsearch Service**
  - Run and scale Elasticsearch clusters
- **Amazon Kinesis**
  - Analyze real-time video and data streams
- **Amazon Redshift**
  - Fast, simple, cost-effective data warehousing
- **Amazon QuickSight**
  - Fast business analytics service
- **AWS Data Pipeline**
  - Orchestration service for periodic, data-driven workflows
- **AWS Glue**
  - Prepare and load data

Source: https://aws.amazon.com/

Machine Learning on AWS

Machine learning in the hands of every developer and data scientist



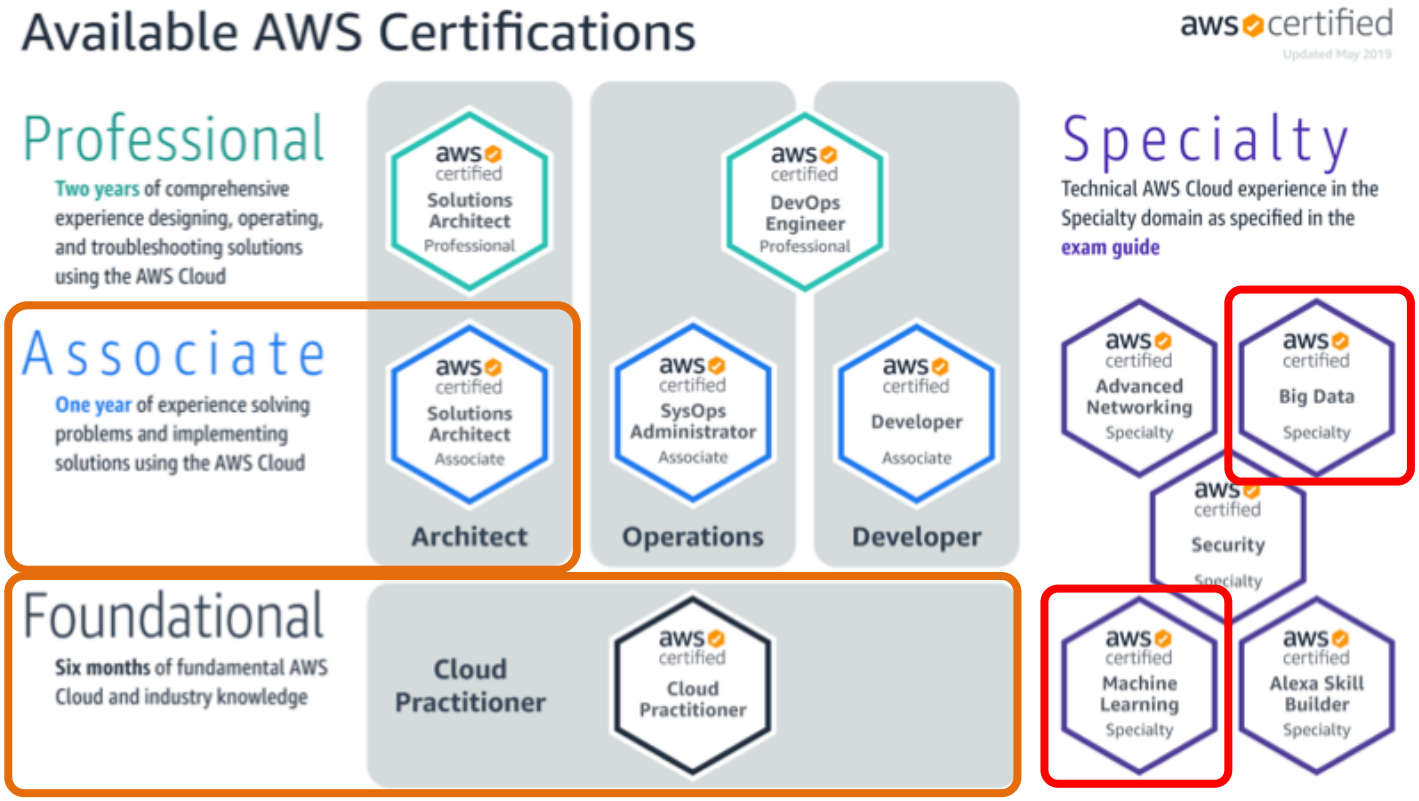
Source: https://aws.amazon.com/machine-learning/

AWS Certified Cloud Practitioner

AWS Certified Solutions Architect

AWS Certified Big Data Specialty

AWS Certified Machine Learning Specialty



Source: https://aws.amazon.com/certification/

Summary

- AI
- Big Data
- Cloud Computing

References

- Ramesh Sharda, Dursun Delen, and Efraim Turban (2017), Business Intelligence, Analytics, and Data Science: A Managerial Perspective, 4th Edition, Pearson.
- Xiao-lin Zheng, Meng-ying Zhu, Qi-bing Li, Chao-chao Chen, and Yan-chao Tan (2019), "Finbrain: When finance meets AI 2.0." Frontiers of Information Technology & Electronic Engineering 20, no. 7, pp. 914-924.
- Ting-Peng Liang and Yu-Hsi Liu (2018), "Research Landscape of Business Intelligence and Big Data analytics: A bibliometrics study", Expert Systems with Applications, 111, no. 30, pp. 2-10.
- Jared Dean (2014), Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners, Wiley.
- Mehmet Kaya, Jalal Kawash, Suheil Khoury, and Min-Yuh Day (2018), Social Network Based Big Data Analysis and Applications, Lecture Notes in Social Networks, Springer International Publishing.
- Varun Grover, Roger HL Chiang, Ting-Peng Liang, and Dongsong Zhang (2018), "Creating Strategic Business Value from Big Data Analytics: A Research Framework", Journal of Management Information Systems, 35, no. 2, pp. 388-423.
- Stuart Russell and Peter Norvig (2016) , Artificial Intelligence: A Modern Approach, 3rd Edition, Pearson International.
- Javier Mata, Ignacio de Miguel, Ramón J. Durán, Noemí Merayo, Sandeep Kumar Singh, Admela Jukan, and Mohit Chamania (2018), "Artificial intelligence (AI) methods in optical networks: A comprehensive survey", Optical Switching and Networking, 28, pp. 43-57
- Stephan Kudyba (2014), Big Data, Mining, and Analytics: Components of Strategic Decision Making, Auerbach Publications.