Introduction to Data Science & related concepts

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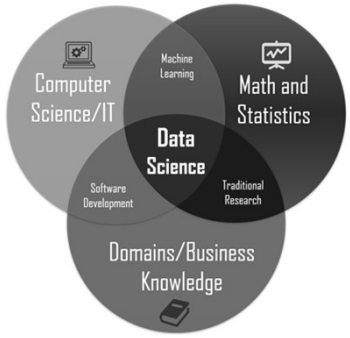
Main Contents

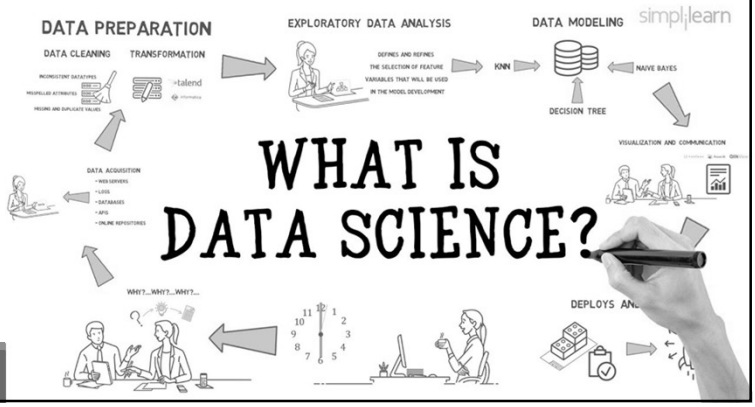
1. Data science
2. Data analytics
3. Business intelligence & Knowledge management
4. Big Data & Data mining
5. Data visualization
6. Artificial Intelligence & Machine Learning
7. Industry 4.0 & future technologies: cloud computing, IOT, VR, AR, Blockchain, FinTech, InsurTech...

1. Data Science (1)

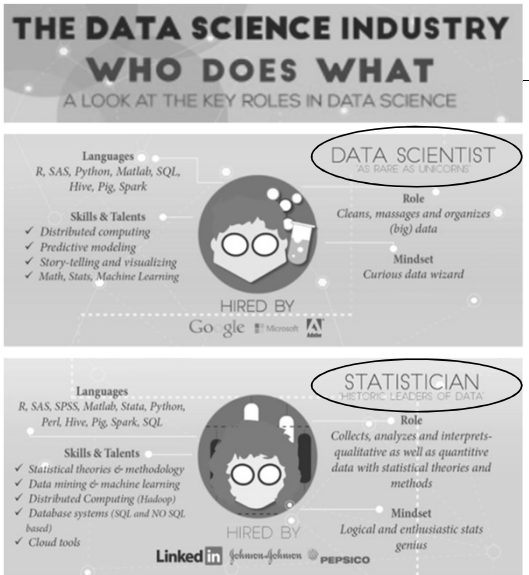
Data Science

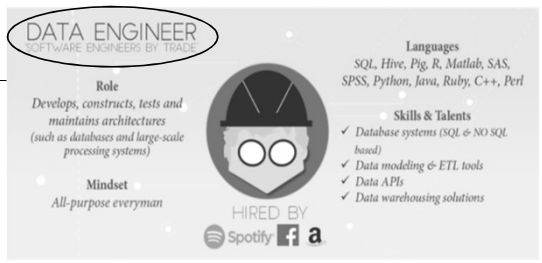
an interdisciplinary field about scientific methods, processes, and systems to extract knowledge or insights from data in various forms, either structured or unstructured, similar to data mining.



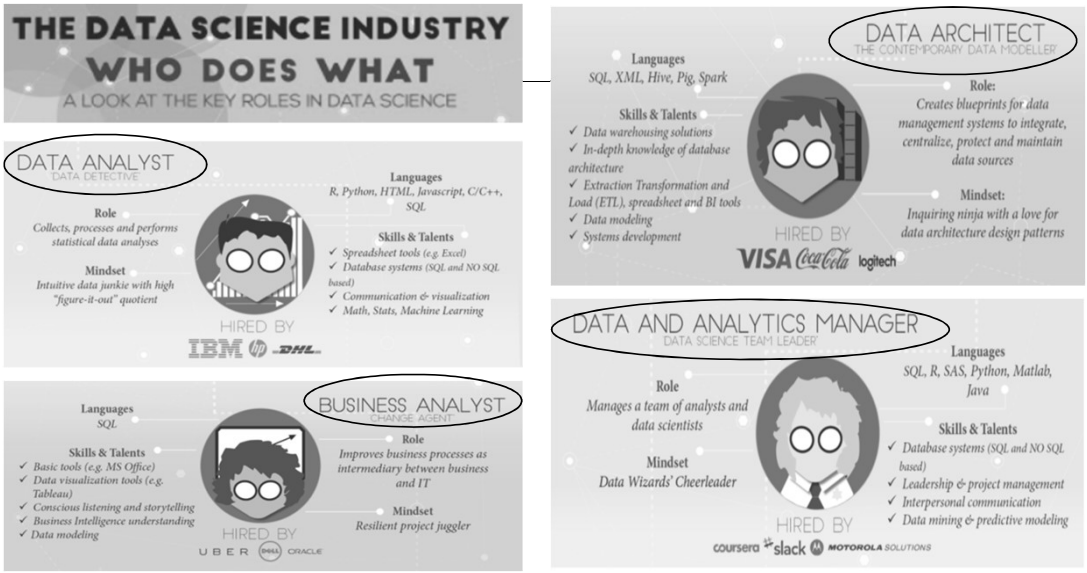


1. Data Science (2)

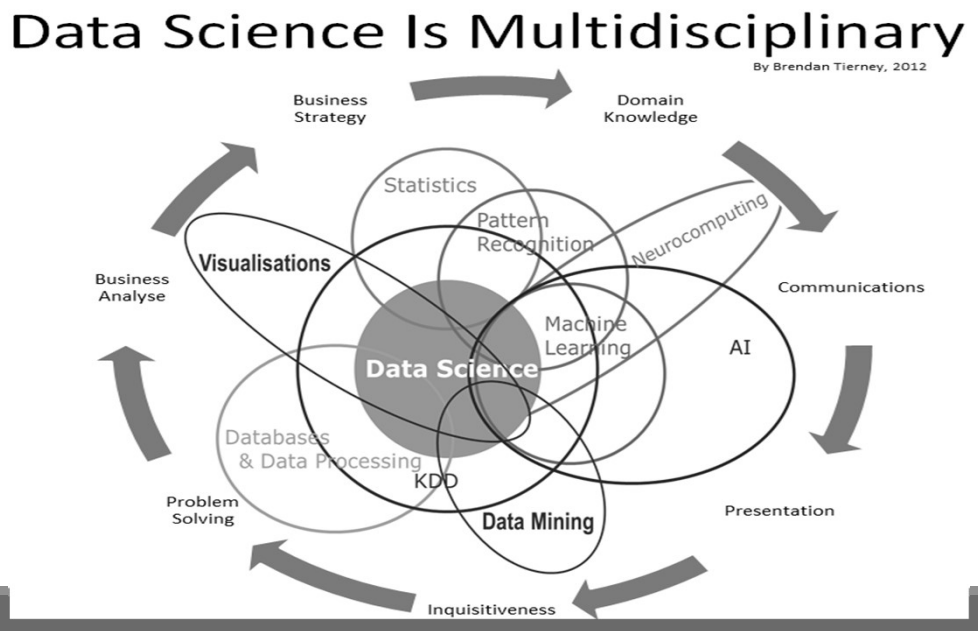




1. Data Science (3)



Data Science



Concentration in Data Science

Mathematics and Applied Mathematics

Applied Statistics/Data Analysis

Solid Programming Skills (R, Python, Julia, SQL)

Data Mining

Data Base Storage and Management

Machine Learning and discovery

2. Data Analytics (1)

Data Analytics (Data Analysis):

qualitative and quantitative techniques and processes

used to enhance productivity and business gain

data is extracted and categorized to identify and analyze behavioral data and patterns

techniques vary according to organizational requirements

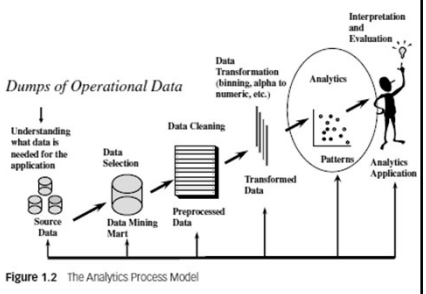
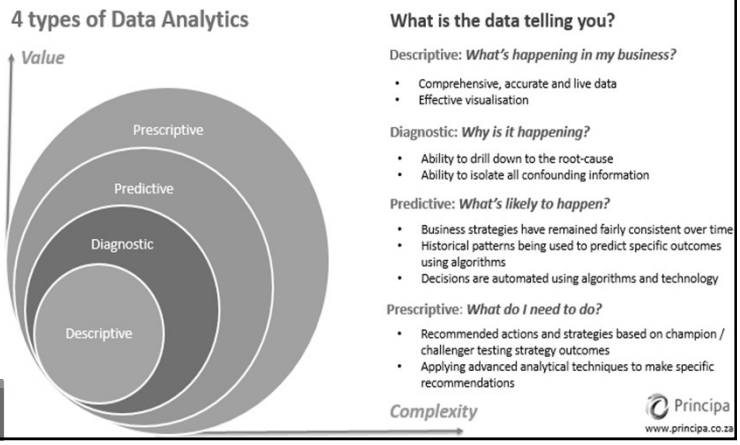


Figure 1.2 The Analytics Process Model



2. Data Analytics (2)

Descriptive Analytics: What is happening?

In business, it provides the analyst with a view of key metrics and measures within the company.

An example of this could be a monthly profit and loss statement. Understanding demographic information on their customers would be categorized as "descriptive analytics".

Utilizing useful visualization tools enhances the message of descriptive analytics.

2. Data Analytics (3)

Diagnostic Analytics: Why is it happening?

On the assessment of the descriptive data, diagnostic analytical tools will empower an analyst to drill down and in so doing isolate the root-cause of a problem.

Well-designed business information (BI) dashboards incorporating reading of time-series data and featuring filters and drill down capability allow for such analysis.

Store Sales Net				Store Type					
Store Country	Store Sta	Store City	Product Family	Deluxe Super	Gourmet Supermar	Mid-Size Groce	Small Grocery	Supermarket	Grand Tota
USA	CA	Beverly Hills	Drink		$2,392.83				$2,392.83
			Food		$20,026.18				$20,026.18
			Non-Consumable		$5,064.79				$5,064.79
		Beverly Hills Total			$27,483.80				$27,483.80
		Los Angeles	Drink					$2,870.33	$2,870.33
			Food					$23,598.28	$23,598.28
			Non-Consumable					$6,305.14	$6,305.14
		Los Angeles Total						$32,773.74	$32,773.74
		San Diego	Drink					$3,050.43	$3,050.43
			Food					$23,627.83	$23,627.83
			Non-Consumable					$6,039.34	$6,039.34
		San Diego Total						$32,717.61	$32,717.61
		San Francisco	Drink				$227.38		$227.38
			Food				$1,960.53		$1,960.53
			Non-Consumable				$474.35		$474.35
		San Francisco Total					$2,662.26		$2,662.26
	CA Total				$27,483.80		$2,662.26	$65,491.35	$95,637.41
	OR		Drink	$4,438.49				$2,862.45	$7,300.94
			Food	$37,778.35				$23,818.87	$61,597.22
			Non-Consumable	$10,177.89				$6,428.53	$16,606.41
	OR Total			$52,394.72				$33,109.85	$85,504.57
	WA		Drink	$3,680.56		$1,409.50	$458.51	$7,968.50	$13,517.07
			Food	$32,497.76		$10,292.19	$4,149.19	$67,915.69	$114,954.83
			Non-Consumable	$8,706.36		$2,813.73	$1,060.54	$17,416.38	$29,997.01
	WA Total			$44,884.68		$14,615.42	$5,668.24	$93,300.57	$158,468.91
USA Total				$97,279.40	$27,483.80	$14,615.42	$8,330.51	$191,901.77	$339,610.90
Grand Total				$97,279.40	$27,483.80	$14,615.42	$8,330.51	$191,901.77	$339,610.90

2. Data Analytics (4)

Predictive Analytics: What is likely to happen?

Predictive analytics is all about forecasting.

Predictive models typically utilize a variety of variable data to make the prediction. The variability of the component data will have a relationship with what it is likely to predict. These data are then compiled together into a score or prediction.

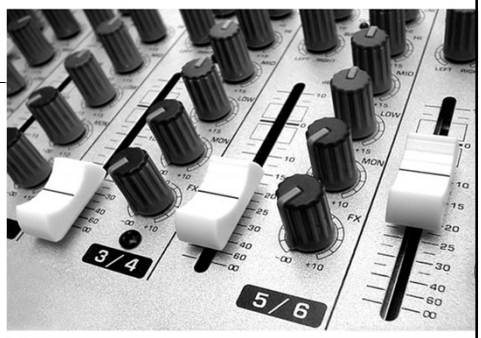
In a world of significant uncertainty, being able to predict allows one to make better decisions.

2. Data Analytics (5)

Prescriptive Analytics: What do I need to do?

The prescriptive model utilizes an understanding of what has happened, why it has happened and a variety of "what-might-happen" analysis to help the user determine the best course of action to take.

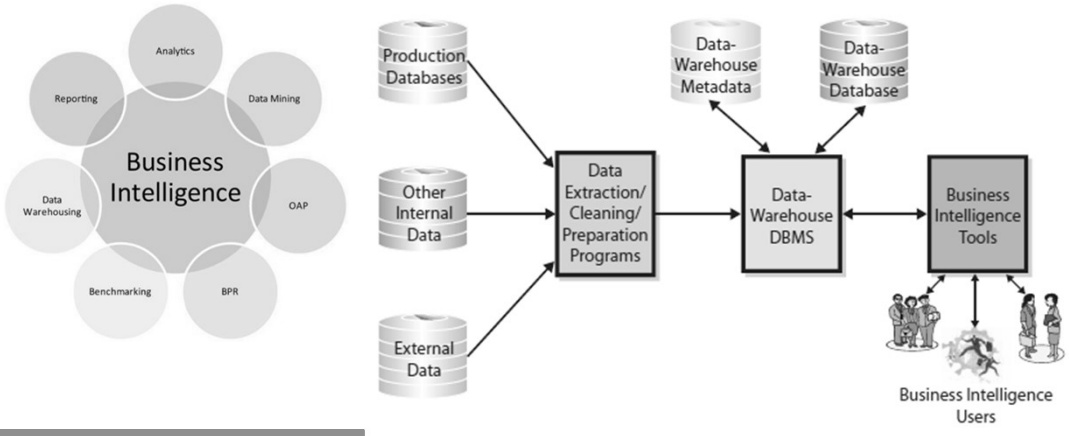
An example of this is a traffic application helping you choose the best route home and taking into account the distance of each route, the speed at which one can travel on each road and, the current traffic constraints.



3. Business intelligence & KMS (1)

Business intelligence

an umbrella term - applications, infrastructure and tools, and best practices that enable access to and analysis of information to improve and optimize decisions and performance.

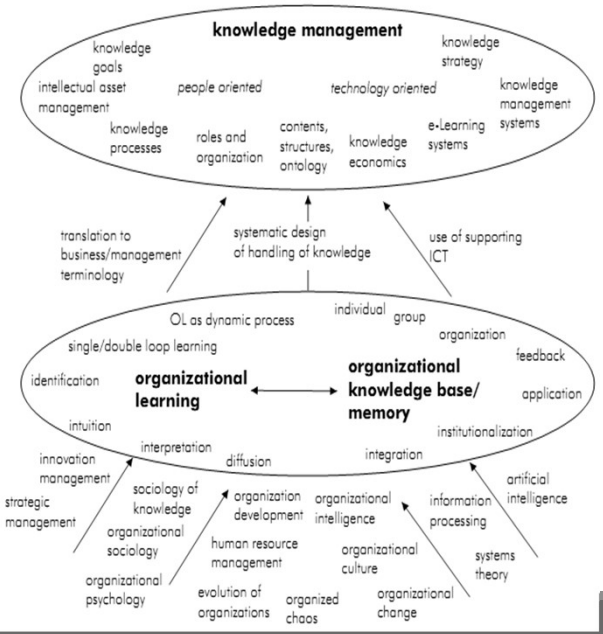


3. Business intelligence & KMS (2)

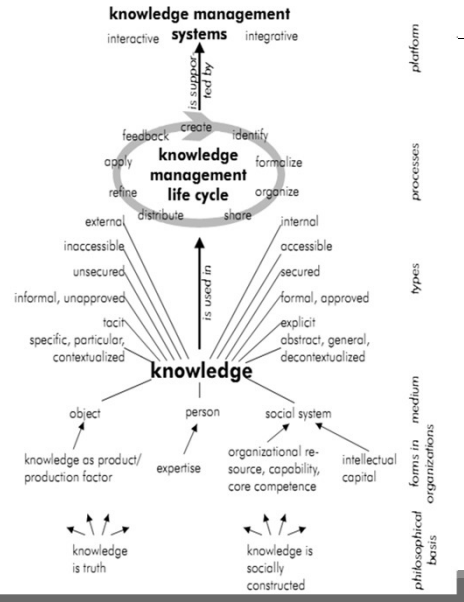
Knowledge management

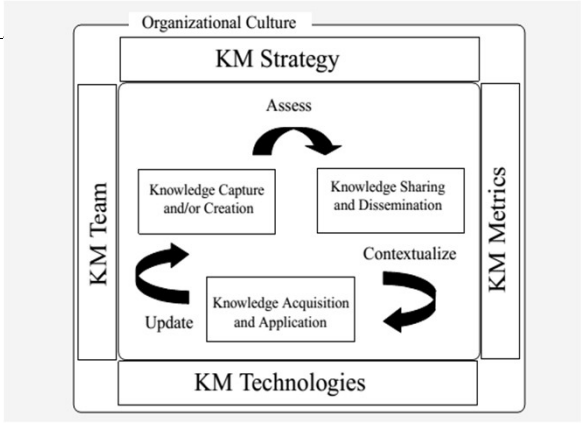
a systematic approach for turning knowledge assets (tacit & explicit) into values.

KMS is a combination of technologies and management practices for identifying, creating, presenting, sharing, & applying knowledge in organization.



3. Business intelligence & KMS (3)





Knowledge management cycle

4. Big Data & Data mining (1)

Big Data:

high-volume, high-velocity, high-variety information assets

demand cost-effective, innovative forms of information processing

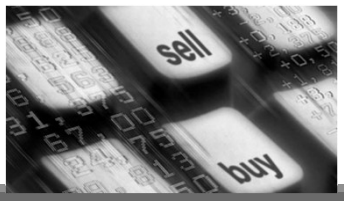
enable enhanced insight, decision making, and process automation

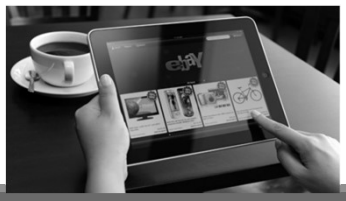
https://www.i-scoop.eu/big-data-action-value-context/

Data All Around

Lots of data is being collected and warehoused

- Web data, e-commerce
- Financial transactions, bank/credit transactions
- Online trading and purchasing
- Social Network





How Much Data Do We have?

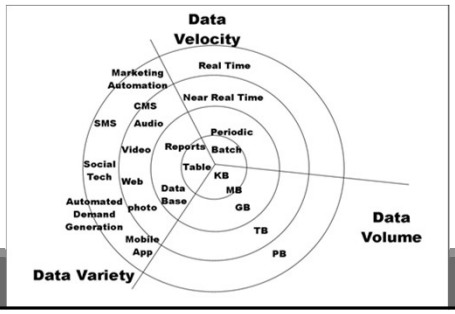
Google processes 20 PB a day (2008)

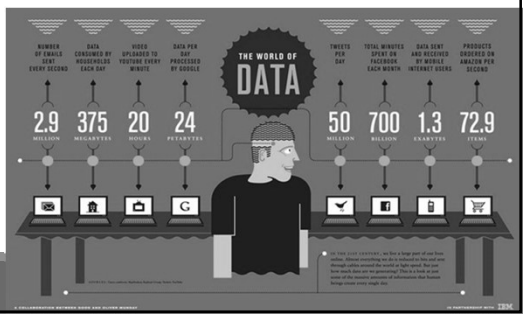
Facebook has 60 TB of daily logs

eBay has 6.5 PB of user data + 50 TB/day (5/2009)

1000 genomes project: 200 TB

- Cost of 1 TB of disk: $35
- Time to read 1 TB disk: 3 hrs (100 MB/s)





Types of Data We Have

Relational Data (Tables/Transaction/Legacy Data)

Text Data (Web)

Semi-structured Data (XML)

Graph Data

Social Network, Semantic Web (RDF), …

Streaming Data

You can afford to scan the data once

What To Do With These Data?

Aggregation and Statistics
- Data warehousing and OLAP

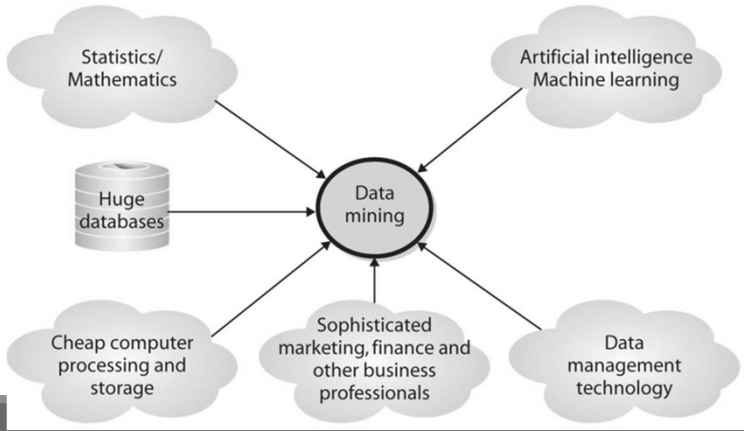
Indexing, Searching, and Querying
- Keyword based search
- Pattern matching (XML/RDF)

Knowledge discovery
- Data Mining
- Statistical Modeling

4. Big Data & Data mining (2)

Data mining

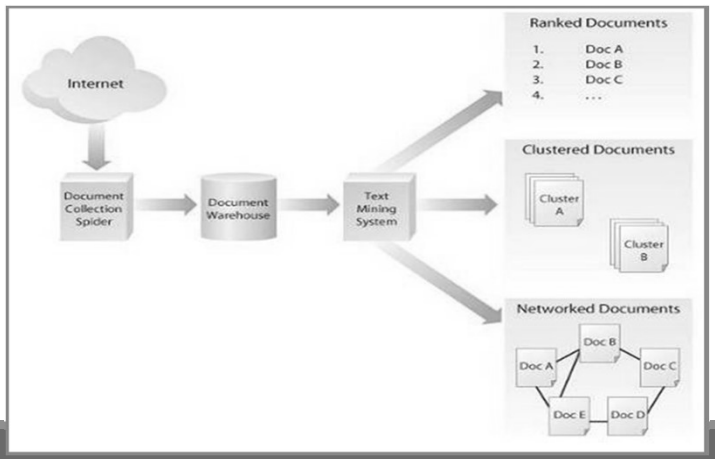
- *use sophisticated statistical techniques, regression analysis and decision tree analysis*
- *used to discover hidden patterns and relationships*
- *market-basket analysis.*



4. Big Data & Data mining (3)

Text mining

A specific form of data mining focusing on the extraction of information from textual documents. Ex: Web crawlers used to extract information from Internet

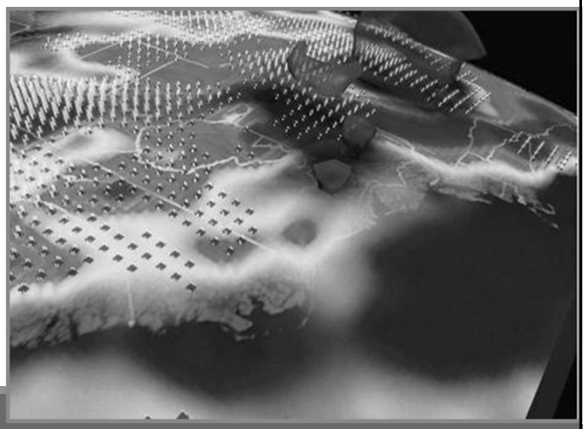


5. Data Visualization

Data Visualization

Tools or techniques to display of complex data relationships using graphical methods

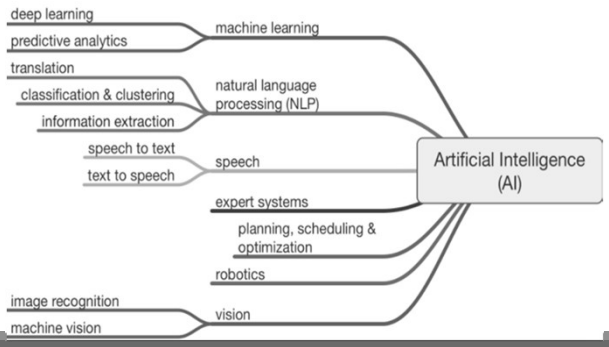
Visualization of a weather system



6. Artificial Intelligence & Machine Learning(1)

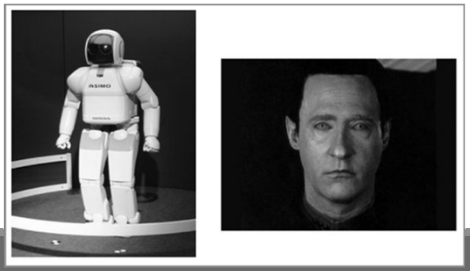
Artificial Intelligence

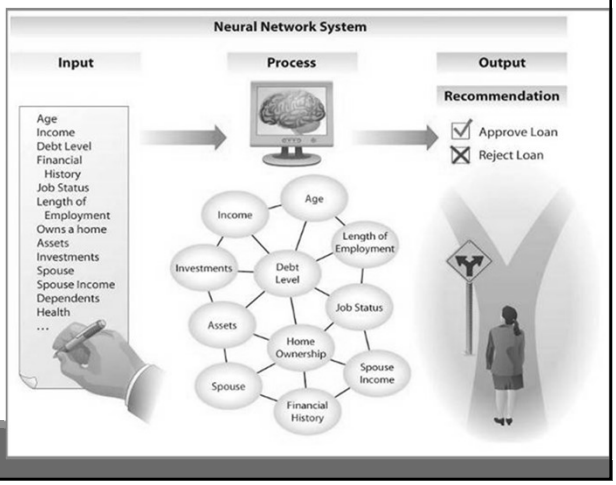
We seek to understand intelligence as manifest in living systems, build artificial systems capable of intelligent reasoning, perception, and behavior, and build principled models of reasoning and thinking applicable to a wide variety of real-world problems.



6. Artificial Intelligence & Machine Learning(2)

- **Intelligent system**
  - Sensors, software and computers
  - Emulate and enhance human capabilities
- **Three types**
  - Expert systems
  - Neural networks
  - Intelligent agents





6. Artificial Intelligence & Machine Learning(3)

Machine Learning

Machine Learning is a subset of artificial intelligence. It could be defined as:
- *method of data analysis that automates analytical model building*
- *algorithms that iteratively learn from data, to find hidden insights*
- *science of getting computers to act without being explicitly programmed*

There are various types of machine learning, the three most common types being: supervised, unsupervised and reinforcement learning.

- In **supervised learning**, training of the algorithms needs to take place. Some applications: speech recognition, medical diagnosis, fraudulent detection, etc.

- In **unsupervised learning**, to detect what is being provided as input and explore the data to find structure and patterns. Unsupervised learning is used in content or product recommendations, like Netflix or Amazon.

- With **reinforcement learning**, a computer needs a continual input of data to improve continually through trial and error approach. Mostly used in developing driverless cars, dynamic pricing strategy or supply chain risk management.

7. Industry 4.0 & future technologies (1)

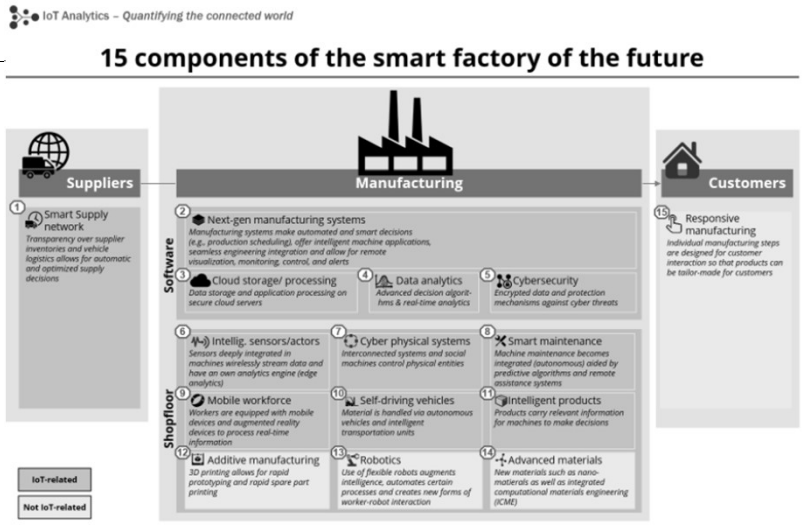
Industry 4.0

First – steam, machines

Second - electricity, assembly line, mass production

Third - computers, beginnings of automation, robots and machines replace human workers on assembly lines.

Fourth – **"smart factory"** in which cyber-physical systems monitor the physical processes of the factory and make decentralized decisions.



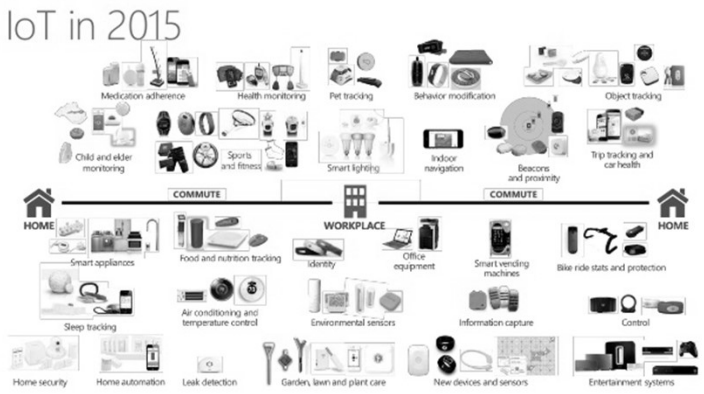
7. Industry 4.0 & future technologies (2)

IoT

In 1999 Kevin Ashton coined the term 'Internet of Things'

flow between:

BAN (body area network): wearables,
LAN (local area network): smart home,
WAN (wide area network): connected car,
and
VWAN (very wide area network): the smart city



7. Industry 4.0 & future technologies (3)

Cloud computing

storing and accessing data and programs over the Internet instead of your computer's hard drive

cloud is also a metaphor for the Internet

Top services or applications moving to the cloud:*

Small business	Medium business	Large business	Federal govt.
1. Storage (40%)	1. Storage (35%)	1. Conferencing & collaboration (40%)	1. Conferencing & collaboration (39%)
2. Conferencing & collaboration (37%)	2. Messaging (33%)	2. Storage/business process apps (35%)	2. Messaging (37%)
3. Messaging (36%)	3. Office & productivity suites (32%)	3. Messaging/ compute power (34%)	3. Business process apps (31%)

State/local govt.	Healthcare	Higher education	K-12
1. Storage (19%)	1. Conferencing & collaboration (29%)	1. Storage (31%)	1. Storage (40%)
2. Conferencing & collaboration (17%)	2. Compute power (26%)	2. Messaging/ conferencing & collaboration (29%)	2. Conferencing & collaboration (36%)
3. Messaging/business process apps/ compute power (15%)	3. Office & productivity suites (22%)	3. Compute power (25%)	3. Office & productivity suites (33%)

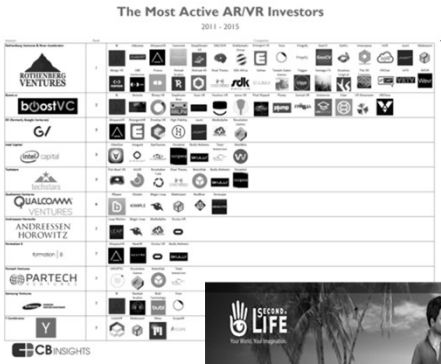
*Those who are migrating or have migrated

7. Industry 4.0 & future technologies (4)

Virtual Reality

a 3-dimensional, computer generated environment which can be explored and interacted with by a person

one becomes part of the virtual world or is immersed within this environment and whilst there, is able to manipulate objects or perform a series of actions.



7. Industry 4.0 & future technologies (5)

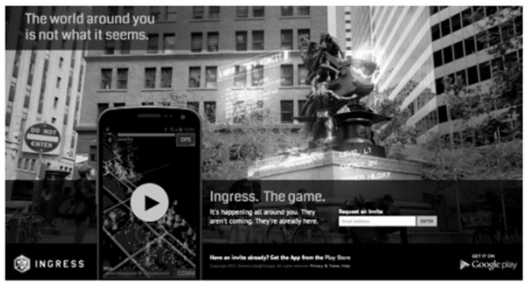
Augmented Reality

technology that layers computer-generated enhancements atop an existing reality

developed into apps and used on mobile devices to blend digital components into the real world

1. Ingress

This App is good news to every gamer in the world. It proves that there is more to the world than what you usually see; if anything, this App is the definition of seeing the world through different eyes.

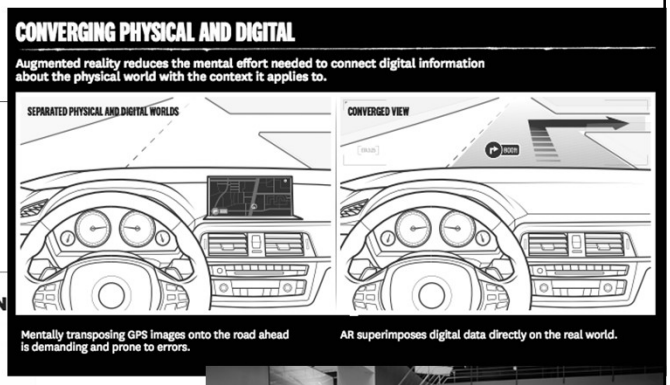


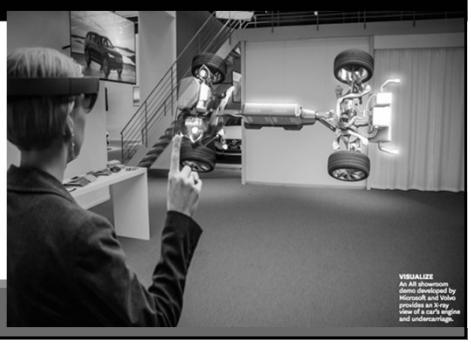
The Ingress Augmented Reality App from Google turns your real life surrounding into capturable objectives in-game portals. Landmarks and points of interest are captured on your phone after it uses GPS technology access your location and gives you a virtual alternative to reality.

7. Industry 4.0 & future technologies (6)

BY MICHAEL E. PORTER AND JAMES E. HEPPELMANN

There is a fundamental disconnect between the wealth of digital data available to us and the physical world in which we apply it. While reality is three-dimensional, the rich data we now have to inform our decisions and actions remains trapped on two-dimensional pages and screens. This gulf between the real and digital worlds limits our ability to take advantage of the torrent of information and insights produced by billions of smart, connected products (SCPs) worldwide.





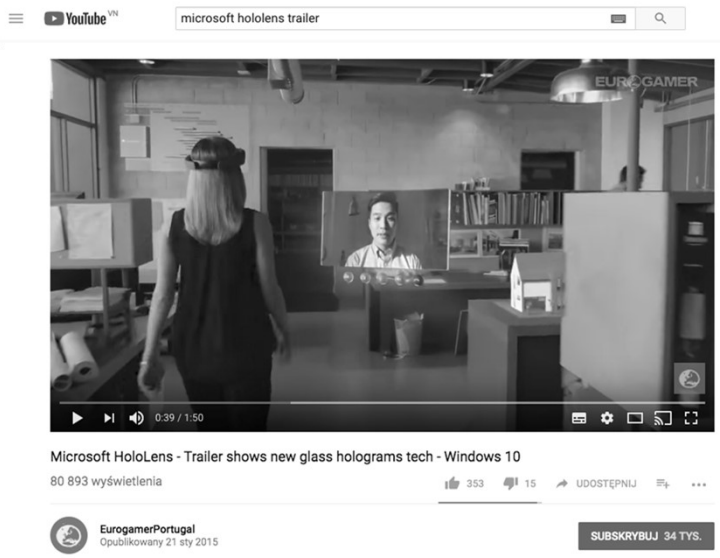
7. Industry 4.0 & future technologies (7)

Mixed Reality

takes AR to the next level

not just a layer on top of the world we see every day

ability to mix digitally rendered objects into our real environment



https://www.youtube.com/watch?v=zEtLqtunD6g

7. Industry 4.0 & future technologies (8)

Crypto currency

digital asset designed to work as a medium of exchange using cryptography to secure the transactions and to control the creation of additional units of the currency

bitcoins and other cryptocurrencies work on the blockchain technology

Bitcoin's price bubble will burst under government pressure

Kenneth Rogoff

The cryptocurrency is up 1,600% in two years – but state efforts to remove its near-anonymity will undermine its popularity

Bitcoin's price is up 600% over the past 12 months Photograph: Alexander Demianchuk/TASS

Is the cryptocurrency bitcoin the biggest bubble in the world today, or a great investment bet on the cutting edge of new-age financial technology? My best guess is that in the long run, the technology will thrive, but that the price of bitcoin will collapse.

If you haven't been following the bitcoin story, its price is up 600% over the past 12 months, and 1,600% in the past 24 months. At over $4,200 (as of 5 October), a single unit of the virtual currency is now worth more than three times an ounce of gold. Some bitcoin evangelists see it going far higher in the next few years.

Warnings grow louder over cryptocurrency as valuations soar

With bitcoin and Ethereum gathering momentum among investors, some experts fear a bubble could soon burst

'It's a game, and it looks very much like a bubble,' says one expert. Photograph: Artyom Korotayev/TASS

Joe Kennedy, patriarch of the Kennedy clan, said he knew it was time to exit the stock market after a shoeshine boy gave him stock tips. If everyone thinks it's time to buy, it's time to sell, reasoned Kennedy. Then came the great crash of 1929 to prove him right. Perhaps some of that thinking could be applied today to the digital currency bonanza.

In recent months, warning voices have grown louder as the digital assets known as cryptocurrencies have attained record valuations. The price of bitcoin, the most famous cryptocurrency, has soared this year, from $969 to more than $5,000 in September; rival Ethereum began the year at $8 and has traded as high as $400 - while new coins or tokens are issued weekly, often attached to tech startups as a way to raise venture capital.

7. Industry 4.0 & future technologies (9)

Blockchain

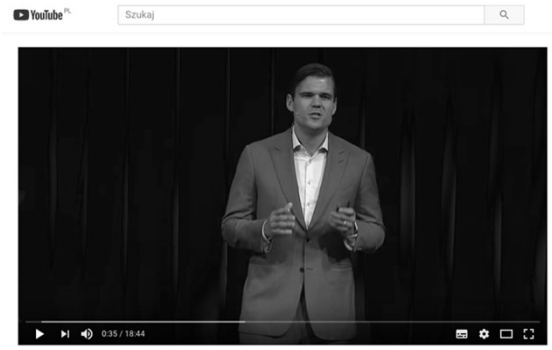
blockchain technology, which is a digital, distributed transaction ledger with identical copies maintained on each of the network's members' computers

all parties can review previous entries and record new ones

transactions are grouped in blocks, recorded one after the other in a chain of blocks (the 'blockchain')

the links between blocks and their content are protected by cryptography, so previous transactions cannot be destroyed or forged

the ledger and the transaction network are trusted without a central authority – a 'middleman'.



Blockchain is Eating Wall Street | Alex Tapscott | TEDxSanFrancisco

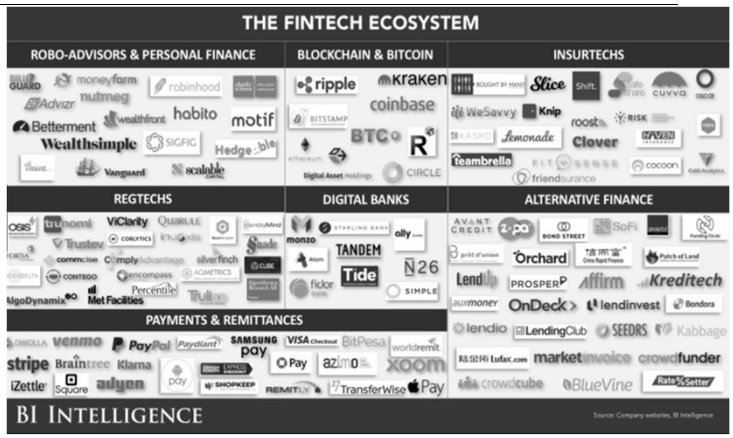
https://www.youtube.com/watch?v=WnEYakUxsHU

7. Industry 4.0 & future technologies (10)

Fintech / Insuretech

emerging financial services sector in the 21st century

technological innovation in the financial sector, including innovations i.e. in financial literacy, retail banking, insurance, investment and crypto-currencies



Thank you for listening!

Discussion

Q & A