WQD7001

Data Science : An Introduction

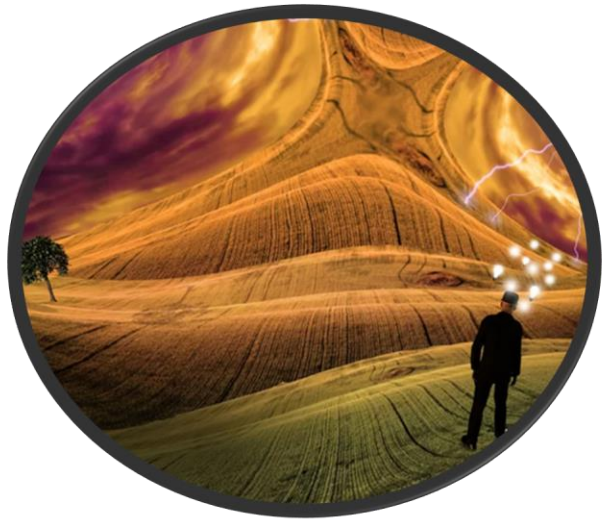
Demystifying the “buzzword” data science

Fundamental Qs

1. Why Data Science Matters?
2. What is Data Science?
3. Who does Data Science?
4. Where is Data Science Used?
5. When is Data Science Applied?
6. How Data Science Works?

Learning Objectives

1. To describe **why** data science matters
2. To construct a definition for data science (the **what**)
3. To identify **who** data scientist are
4. To determine **where** and **when** data science is used / applied
5. To summarize **how** data science works



What ONE word that appears in your mind when you hear the term “Data Science”?

Pondering Questions

Q1 - Is Data Science new?

Q2 - Is Data Science the same as Statistics and Analysis?

Q3 - Do you need big data to do Data Science?

Q1 - Is Data Science New?

1962, JW Tukey, *"The Future of Data Analysis"*

"For a long time I have thought I was a statistician, interested in inferences from the particular to the general. But as I have watched mathematical statistics evolve, I have had cause to wonder and to doubt…I have come to feel that my central interest is in data analysis, which I take to include, among other things: procedures for ***analyzing data****, techniques for* ***interpreting the results*** *of such procedures, ways of planning the* ***gathering of data*** *to make its analysis easier, more precise or more accurate, and all the* ***machinery and results of (mathematical) statistics*** *which apply to analyzing data."*

1997, **C.F. Jeff Wu** gave an inaugural lecture titled simply "Statistics =Data Science?"

2008. The term "data scientist" is often attributed to **Jeff Hammerbacher** (now, founder and Chief Scientist of Cloudera) and DJ Patil.

Brief History of Data Science

6th C BC - 1st C BC – **The Greeks!** Pyrrhonism, Skepticism & Empiricism…

1966 – Peter Naur @UoC Datalogy & Data Science

2001 – William S. Cleveland [redacted] "Data Science: An Action Plan …: **@Purdue University**

2002 – Committee on Data for Science & Technology (CODATA)

2003 – Journal of Data Science

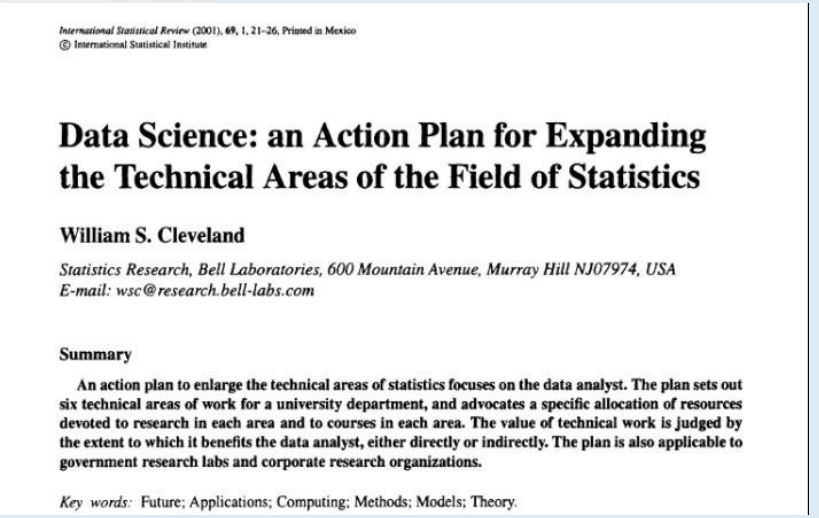
2009 – Jeff Hammerbacher @ Facebook What does a Data Scientist Do?

2010 – Drew Conway @NYU The Data Science Venn Diagram

2010 – Hillary Mason & Chris Wiggins @Dataists "

2010 – Mike Loukadis @O'Reilly "What is Data Science?"

2011 – DJ Patil @LinkedIn data scientist vs. data analyst



International Statistical Review (2001), **69**, 1, 21–26, Printed in Mexico
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Data Science: an Action Plan for Expanding the Technical Areas of the Field of Statistics

William S. Cleveland

Statistics Research, Bell Laboratories, 600 Mountain Avenue, Murray Hill NJ07974, USA
E-mail: wsc@research.bell-labs.com

Summary

An action plan to enlarge the technical areas of statistics focuses on the data analyst. The plan sets out six technical areas of work for a university department, and advocates a specific allocation of resources devoted to research in each area and to courses in each area. The value of technical work is judged by the extent to which it benefits the data analyst, either directly or indirectly. The plan is also applicable to government research labs and corporate research organizations.

Key words: Future; Applications; Computing; Methods; Models; Theory.

The Science of Datalogy

EDITOR:

This is to advocate that the following new **words**, denoting various aspects of our subject, be considered for general adoption (the stress is shown by an accent):

datálogy, the science of the nature and use of data,

datum&tics, that part of datalogy which deals with the processing of data by automatic means,

datámaton, an automatic device for processing data.

In this terminology much of what is now referred to as "data processing" would be datamatics. In many cases this will be a gain in clarity because the new word includes the important aspect of data representations, while the old one does not. Datalogy might be a suitable replacement for "computer science."

The objection that possibly one of these words has already been used as a proper name of some activity may be answered partly by saying that of course the subject of datamatics is written with a lower case d, partly by remembering that the word "electronics" is used doubly in this way without inconvenience.

What also speaks for these words is that they will transfer gracefully into many other languages. We have been using them extensively in my local environment for the last few months and have found them a great help.

Finally I wish to mention that datamatics and datamaton (Danish: datamatik and datamat) are due to Paul Lindgreen and Per Brinch Hansen, while datalogy (Danish: datalogi) is my own invention.

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The science of datalogy

Full Text: PDF

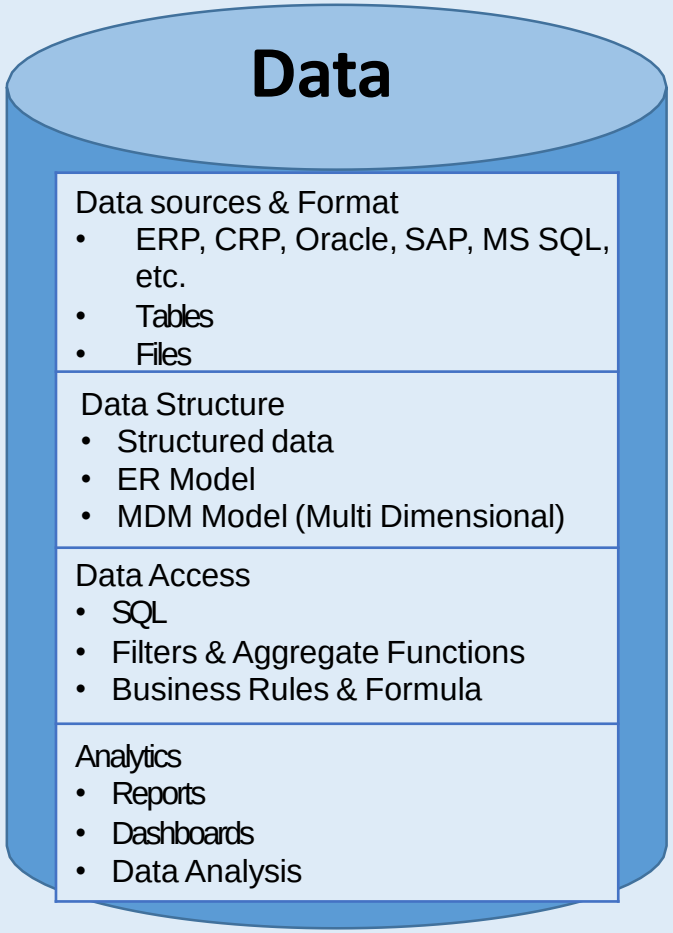
Author: Peter Naur A/S Regnecentralen, Copenhagen, Denmark

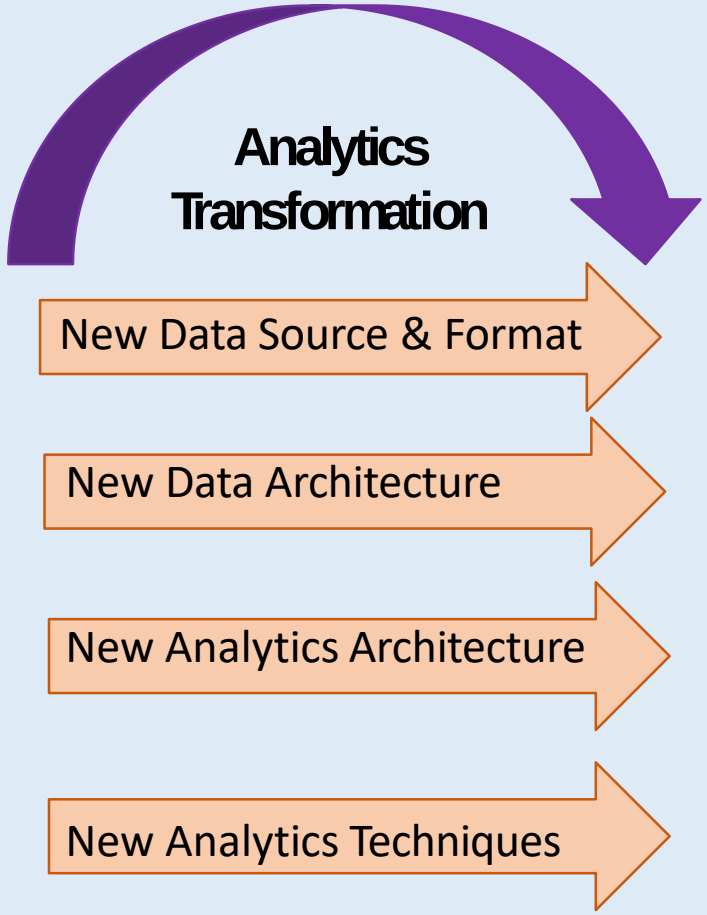
Published in:

· Magazine
Communications of the ACM CACM Homepage archive
Volume 9 Issue 7, July 1966
Page 485
ACM New York, NY, USA
table of contents doi>10.1145/365719.366510

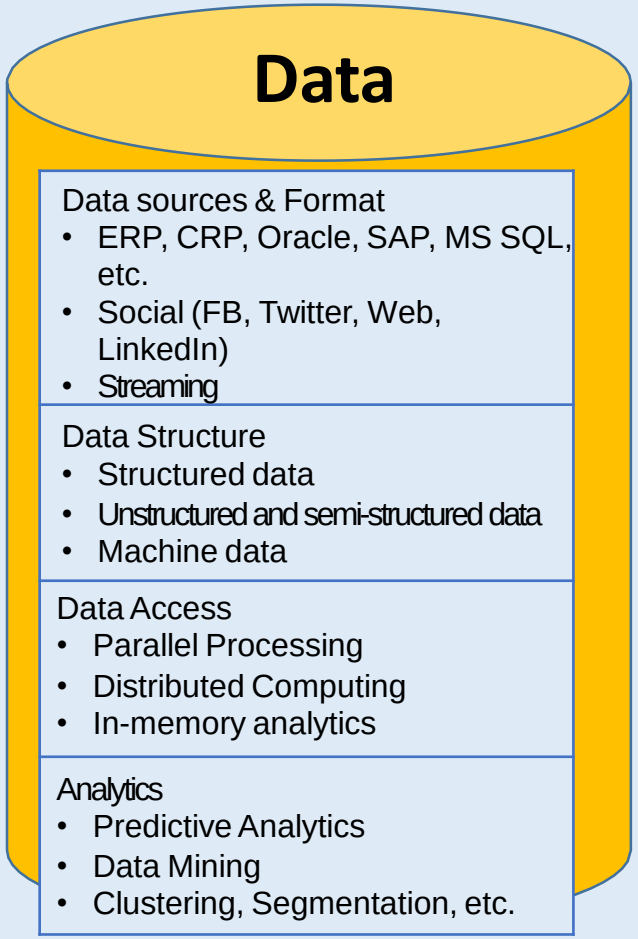
Keyword: Transformation

Traditional Approach to Data & Analytics





Modern Approach to Data & Analytics = Data Science



Modernizing existing reporting, data management, data warehousing, analytics and BI solutions

New thinking, new ideas, innovation → new ways of solving problems

In 2008, **Dr DJ Patil** and **Jeff Hammerbacher**, heads of analytics and data at LinkedIn and Facebook respectively, coined the term '**data science**' to describe the emerging field of study that focused on teasing out the hidden value in the data that was being collected from **touchpoints** all over the retail and business sectors.

Top data scientist D J Patil's Tips to Build a Career in Data

https://www.youtube.com/watch?v=UuAJMzpoq5E

Q2 - Is it the same as Statistics or Analysis?

"I think data-scientist is a sexed up term for a statistician.... Statistics is a branch of science. Data scientist is slightly redundant in some way and people shouldn't berate the term statistician."

Nate Silver, Statistician

Analyzing data is something people have been doing with statistics and related methods for a while.

It's all about the difference between explaining and predicting.

Data analysis has been **generally used** as a way of explaining some phenomenon by extracting interesting patterns from individual data sets with well-formulated queries.

Data science, on the other hand, aims to discover and extract actionable knowledge from the data, that is, knowledge that can be used to make decisions and predictions, not just to explain what's going on.

- **Statistical analysis** is used in order to gain an understanding of a larger population by analyzing the information of a sample. Statistical analysis allows inferences to be drawn about target markets, consumer cohorts and the general population by expanding findings appropriately to predict the behavior and characteristics of the many based on the few.

- **Data analysis** is the process of inspecting, presenting and reporting data in a way that is useful to non-technical people. Because data is next to useless if it can't be understood by the decision-makers who need to use it, data analysts act as translators between the numbers and figures and the people who need to know about them.

Statistics is part of Data Science.

Analysis is part of Data Science.

Q3 - Do you need Big Data to do Data Science?

BY VASANT DHAR

Data Science and Prediction

USE OF THE term "data science" is increasingly common, as is "big data." But what does it mean? Is there something unique about it? What skills do "data scientists" need to be productive in a world deluged by data? What are the implications for scientific inquiry?

including our confidence in the inference. Why then do we need a new term like data science when we have had statistics for centuries? The fact that we now have huge amounts of data should not in and of itself justify the need for a new term.

The short answer is data science is different from statistics and other existing disciplines in several important ways. To start, the raw material, the "data"

The differences between small, medium, and Big data (**Michael E Driscoll**)

class	size	manage with	how it fits	examples
small	< 10 GB	Excel, R	fits in one machine's memory	thousands of sales figures
medium	10GB-1TB	indexed files, monolothic DB	fits on one machine's disk	millions of web pages
Big	> 1TB	Hadoop, distributed DBs	stored across many machines	billions of web clicks

Data Scenario

Society is becoming **increasingly reliant on data** and the **tools and methods** to acquire and analyze it. Important sources of data that are only starting to be explored come from:

- social media,
- full-text scientific literature,
- video material,
- click and interaction patterns,
- financial transactions,
- customer behavior,
- sensors and scientific instrumentation.

We can only fully utilize data if we have the methodologies to **store**, **process** and **transform** it into valuable and **accessible** information by **analysis and modelling**.

Being able to **fully utilize data** will, for example, improve healthcare quality, government efficiency, military effectiveness, steer innovation in business, and forge new scientific discoveries.

Data are Everywhere

When people think of data

Being actively collected, stashed away in databases on inscrutable corporate servers and funneled into research.

Data is much more **ubiquitous**.

It is the **by-product** of any and every action, pervading every part of our lives.
Wherever we go, whatever we buy, whatever interests we have, this data is all being collected and remodeled into trends that help advertisers and marketers push their products to the right people.

'Data are not taken for museum purposes; they are taken as a basis for doing something. If nothing is to be done with the data, then there is no use in collecting any. The ultimate purpose of taking data is to provide a basis for action or a recommendation for action.'

W. Edwards Deming, 1942

PRICEONOMICS

In Data We Trust | CONTENT BOOTCAMP | DATA STUDIO | TRACKER | DATA VISUALIZATION

Companies Collect a Lot of Data, But How Much Do They Actually Use?

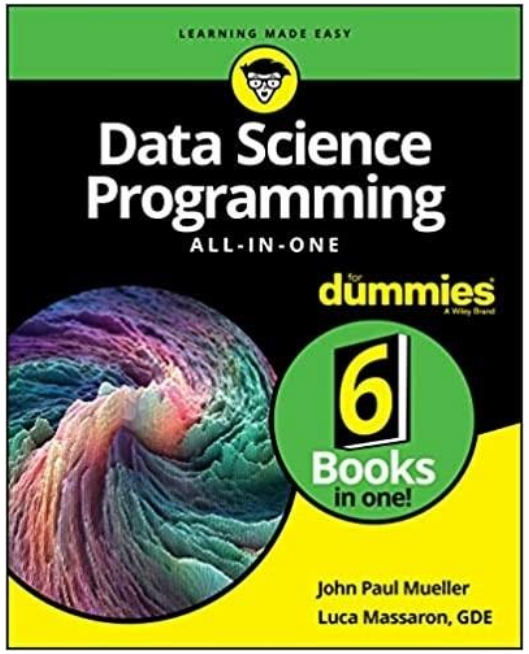
By Priceonomics Data Studio · 3,200 views · More stats

For all the talk of how data is the new oil and the most valuable resource of any enterprise, there is a deep dark secret companies are reluctant to share — most of the data collected by businesses simply goes unused.

This unknown and unused data, known as dark data comprises more than half the data collected by companies. Given that some estimates indicate that 7.5 septillion (7,700,000,000,000,000,000,000) gigabytes of data are generated every single day, not using most of it is a considerable issue.

Gartner defines **dark data** as:
"The information assets organizations collect, process and store during regular business activities, but generally fail to use for other purposes (for example, analytics, business relationships and direct monetizing).

https://priceonomics.com/companies-collect-a-lot-of-data-but-how-much-do/



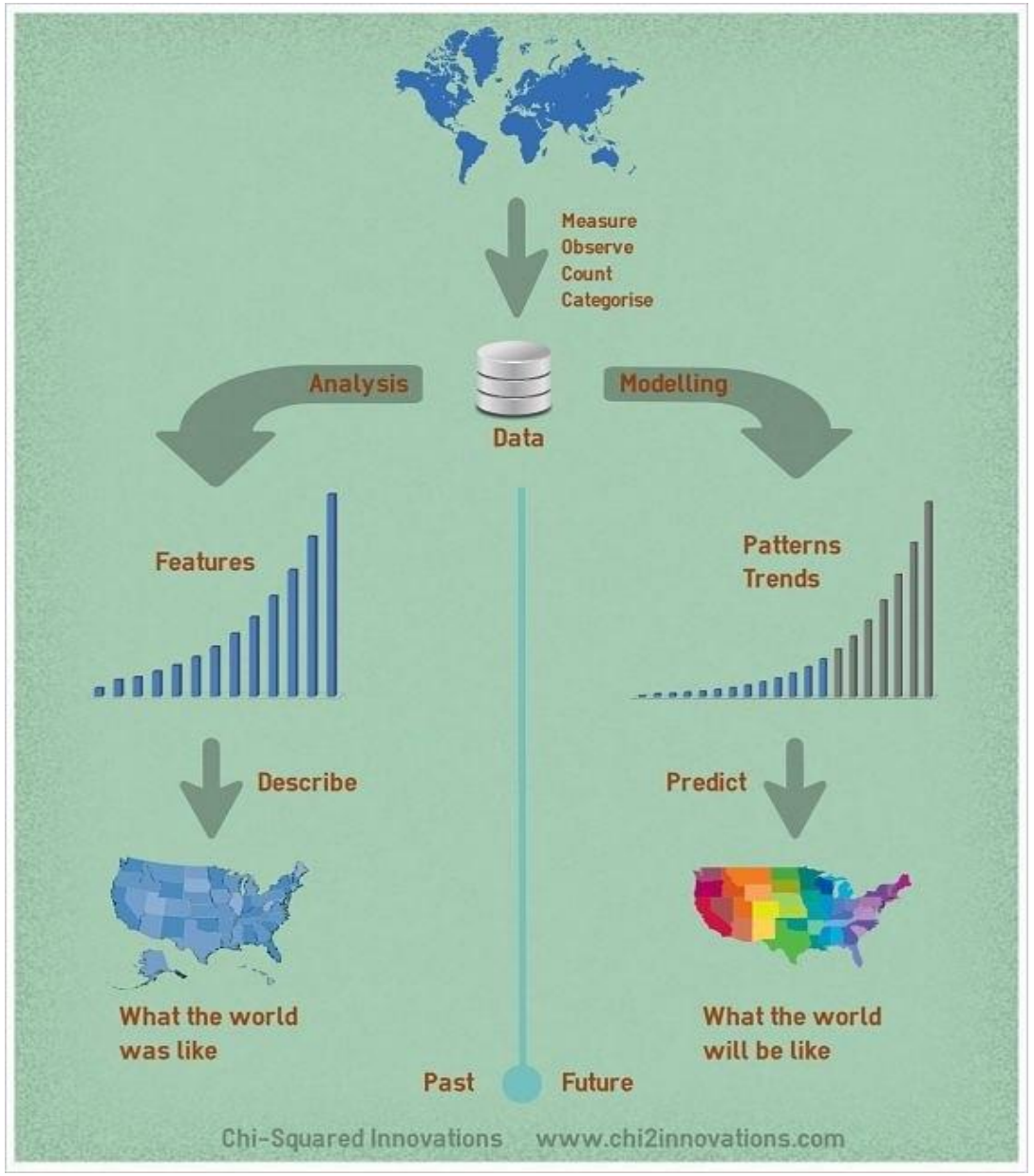
Making life more interesting in other ways

Data is part of your life. You really can't perform too many activities anymore that don't have data attached to them in some way. For example, consider gardening. You might think that digging in the earth, planting seeds, watering, and harvesting fruit has nothing to do with data, yet the seeds you use likely rely on research conducted as the result of gathering data. The tools you use to dig are now ergonomically designed based on human research studies. The weather reports you use to determine whether to water or not rely on data. The clothes you wear, the shoes you employ to work safely, and even the manner in which you work are all influenced by data. Now, consider that gardening is a relatively nontechnical task that people have performed for thousands of years, and you get a good feel for just how much data affects your daily life.

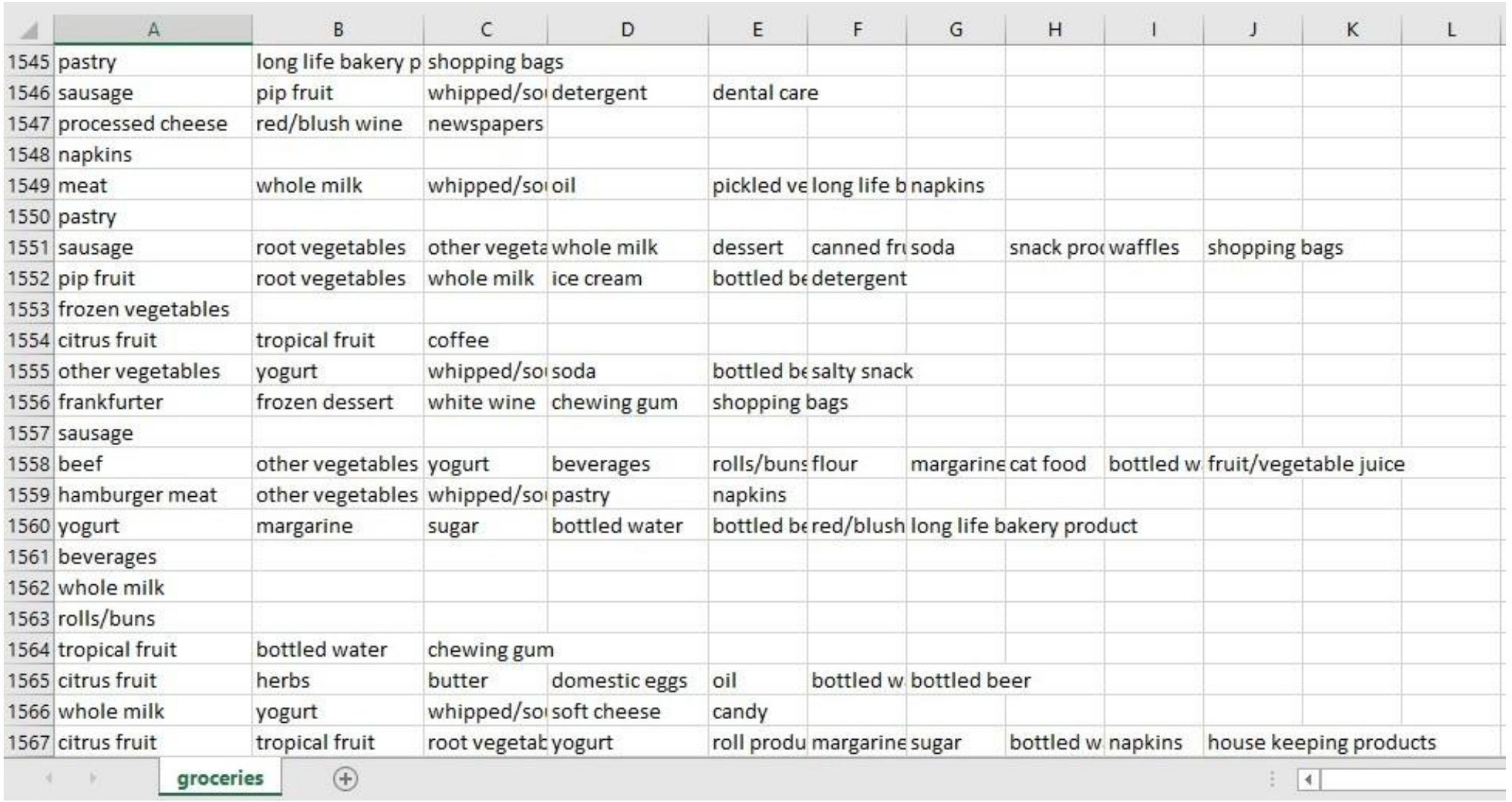
What do we do with the data?

We typically collect data to answer one of 2 questions:

- ❑ What is the world like?
- ❑ What is the world going to be like?



The Groceries Dataset



	A	B	C	D	E	F	G	H	I	J	K	L
1545	pastry	long life bakery p	shopping bags									
1546	sausage	pip fruit	whipped/so	detergent	dental care							
1547	processed cheese	red/blush wine	newspapers									
1548	napkins											
1549	meat	whole milk	whipped/so	oil	pickled ve	long life b	napkins					
1550	pastry											
1551	sausage	root vegetables	other vegeta	whole milk	dessert	canned fr	soda	snack pro	waffles	shopping bags		
1552	pip fruit	root vegetables	whole milk	ice cream	bottled be	detergent						
1553	frozen vegetables											
1554	citrus fruit	tropical fruit	coffee									
1555	other vegetables	yogurt	whipped/so	soda	bottled be	salty snack						
1556	frankfurter	frozen dessert	white wine	chewing gum	shopping bags							
1557	sausage											
1558	beef	other vegetables	yogurt	beverages	rolls/buns	flour	margarine	cat food	bottled w	fruit/vegetable juice		
1559	hamburger meat	other vegetables	whipped/so	pastry	napkins							
1560	yogurt	margarine	sugar	bottled water	bottled be	red/blush	long life bakery product					
1561	beverages											
1562	whole milk											
1563	rolls/buns											
1564	tropical fruit	bottled water	chewing gum									
1565	citrus fruit	herbs	butter	domestic eggs	oil	bottled w	bottled beer					
1566	whole milk	yogurt	whipped/so	soft cheese	candy							
1567	citrus fruit	tropical fruit	root vegetab	yogurt	roll produ	margarine	sugar	bottled w	napkins	house keeping products		

groceries

Groceries Data Set contains: a collection of receipts with each line representing 1 receipt and the items purchased. Each line is called a ***transaction*** and each column in a row represents an ***item***.

Market Basket Use-Case

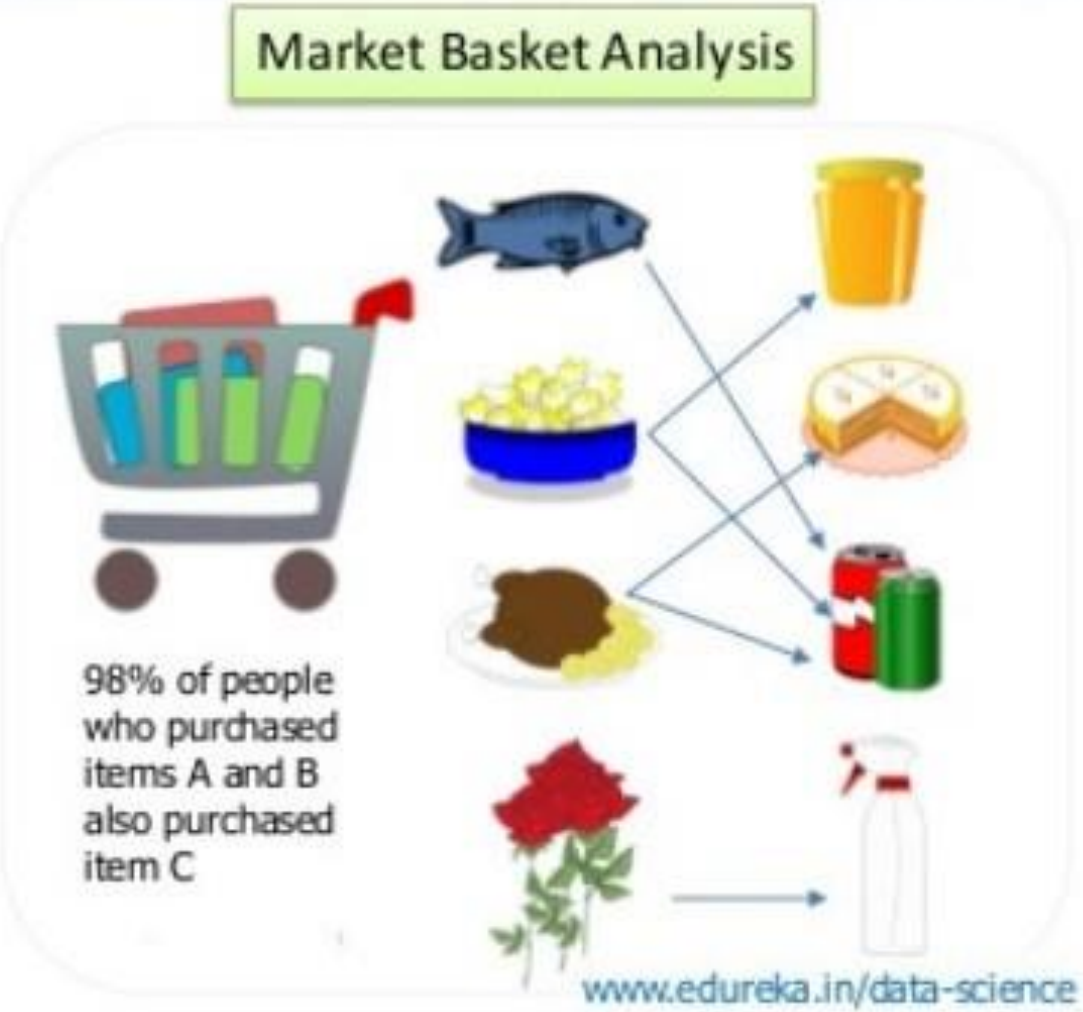
Domain of the Dataset:

Products and Retail. However, the application of the algorithm is not limited to only Products and Retail. The technique can be applied wherever we want to discover the co-occurrence relationship amongst various activities.

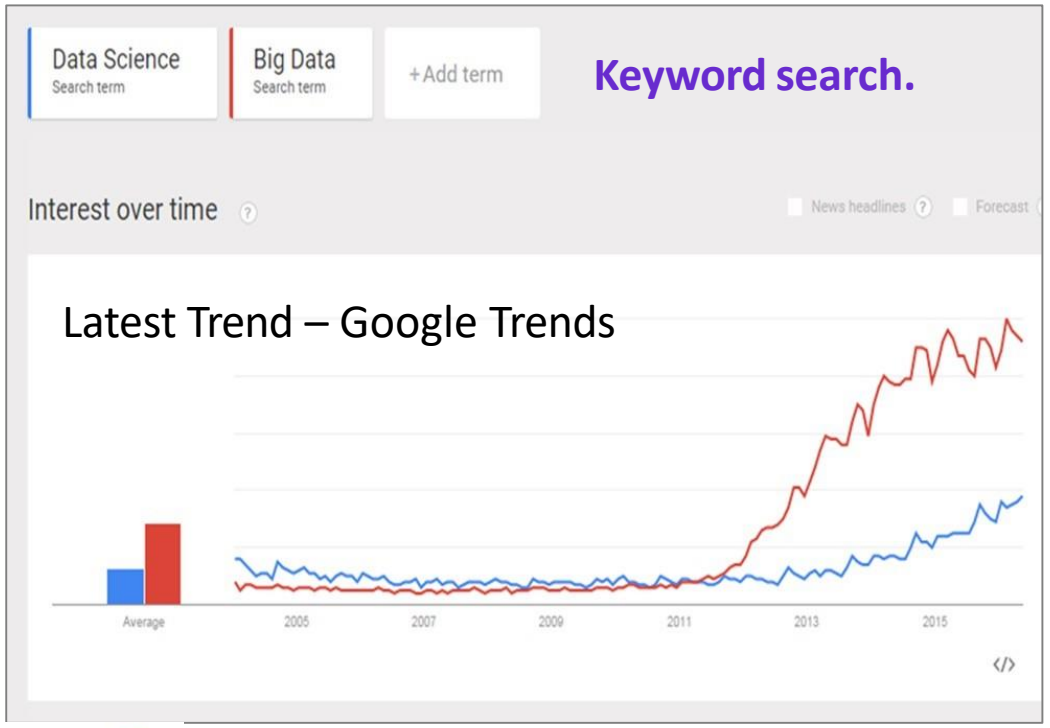
Problem Statement:

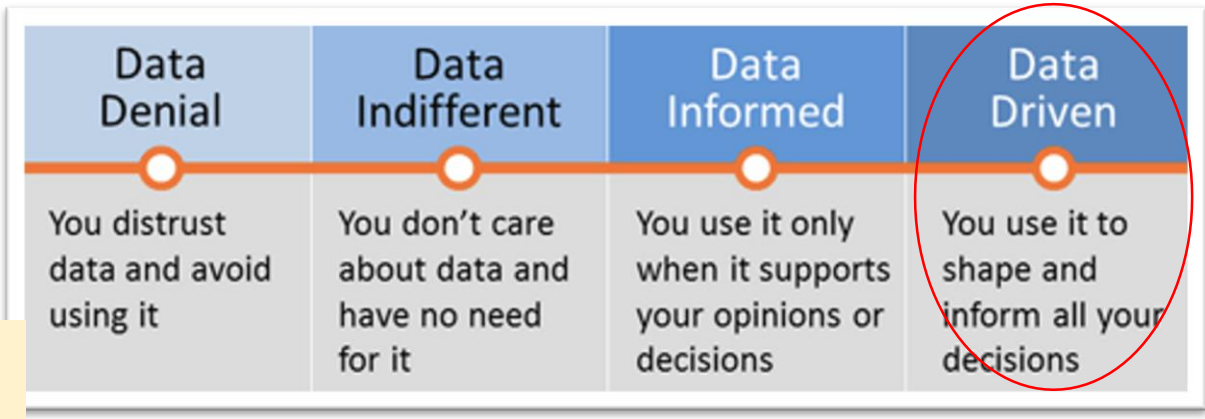
Market Basket Analysis.
A retail outlet wants understand the purchase behavior of a buyer. This information will enable the retailer to understand the buyer's needs.

The analysis might tell a retailer that customers often purchase shampoo and conditioner together, so putting both items on promotion at the same time would create a significant increase in profit, while a promotion involving just one of the items would likely drive sales of the other.



WHY Data Science?





REALITY CHECK

NEED: the future is increasingly complex and *difficult to predict*.

NEED: we don't have enough *qualified experts*, and experts often get it wrong.

RAW MATERIALS: we are generating *huge amounts of data* at an increasing rate.

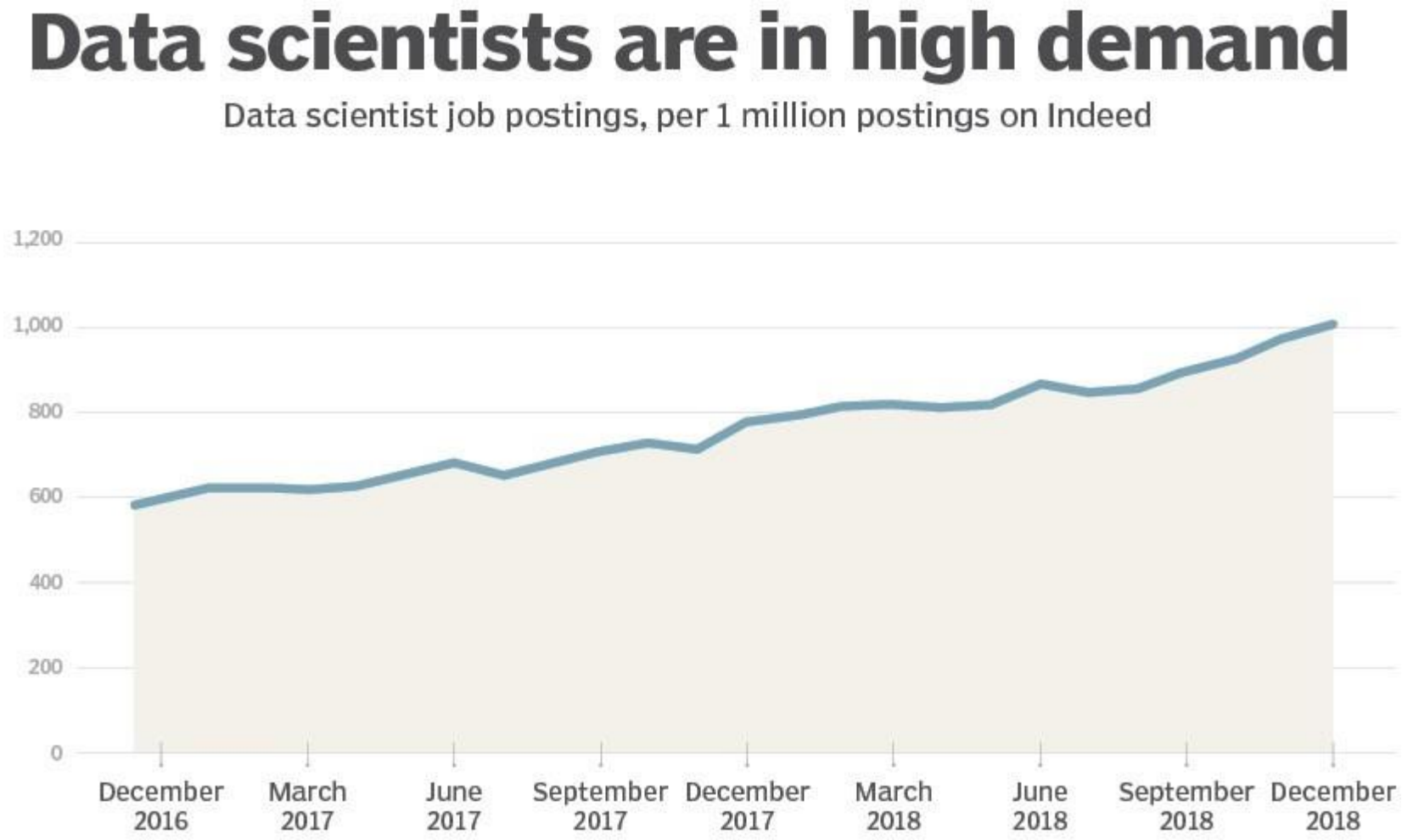
ENABLER: new *hardware and software* tools are emerging.

THEREFORE: Data science is ***inevitable!*** We don't have a choice.

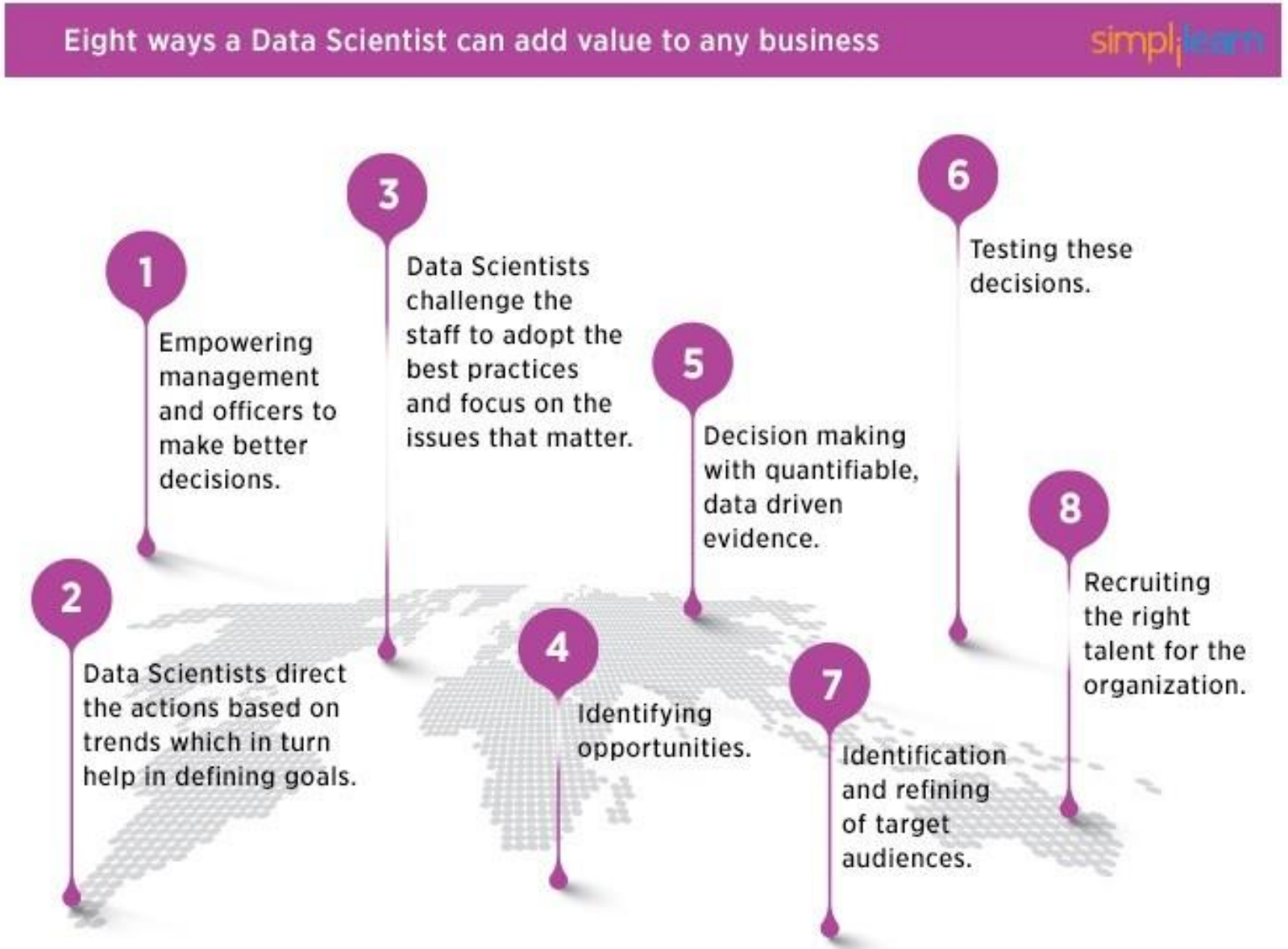
Data-driven decision making

↑ Accuracy

↑ Efficiency



The growth in data scientist job postings on Indeed, from December 2016 to December 2018



Source: https://www.simplilearn.com/why-and-how-data-science-matters-to-business-article

Video

"Data Science: Where are We Going?" - Dr. DJ Patil (12:59 minutes)
https://www.youtube.com/watch?v=3_1reLdh5xw

USA first Chief Data Scientist

Former U.S. Chief Data Scientist

Head Of Technology

Devoted Health

Sep 2017 – Present · 1 yr 1 mo

San Francisco Bay Area & Boston

Data – The Raw Materials

DATA - Facts and statistics collected together for reference or analysis. Watch the video on "What is Data?" https://www.youtube.com/watch?v=EMHP-q4GEDc

"Data –Information – Knowledge" https://www.youtube.com/watch?v=QsP5WGv0aQc

SCIENCE - A systematic study through observation and experiment. What is Science? https://www.youtube.com/watch?v=hDQ8ggroeE4

How does do science? | Figuring out what's true https://www.youtube.com/watch?v=3MRHcYtZjFY

DATA SCIENCE - The **scientific** exploration of **data** to extract meaning or insight, and the construction of software to utilize such insight in a business context.

Transform data into valuable insights

Transform data into data products

Transform data into interesting stories

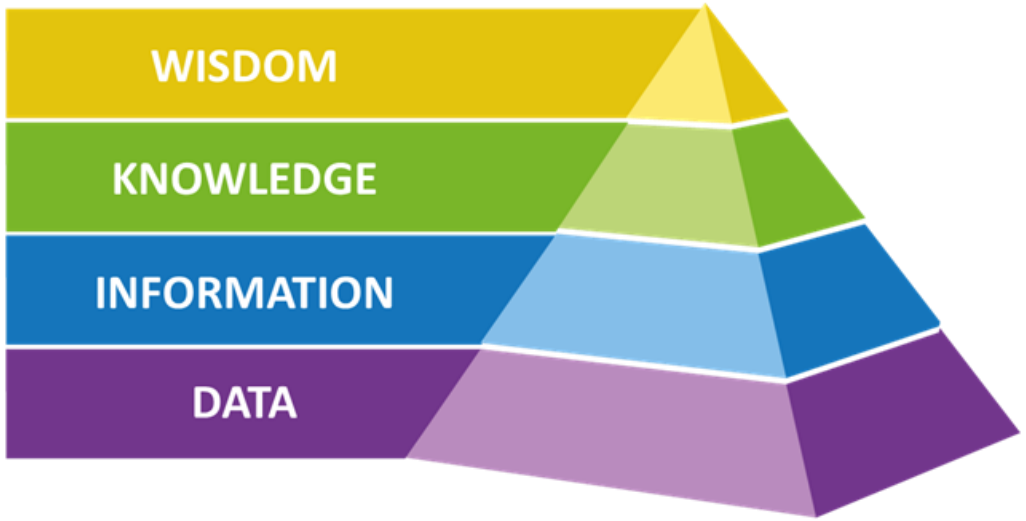


Table 2-1. Levels and definitions of data, information, knowledge, and wisdom (Ackoff, 1989).

Concept	Definition
Data	Unprocessed facts and figures without interpretation or analysis
Information	Data given meaning that benefits the user
Knowledge	Combination of information, experience, and insight that benefits the user
Wisdom	Extrapolative and non-deterministic extension of knowledge

WHAT is Data Science?

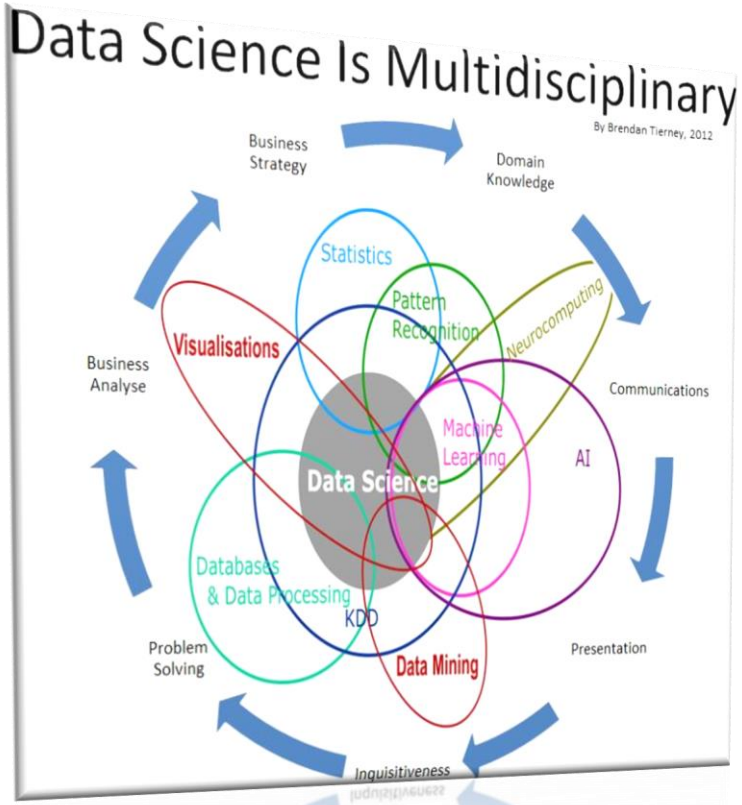
"We have lots of data – now what?"
(How can we unlock valuable insight from our data?)

The discipline of drawing useful conclusions from data using computation.

Data science is a broad field that refers:

- to the collective processes, theories, concepts, tools and technologies that enable the review, analysis and extraction of valuable knowledge and information from raw data.
- It is geared toward helping individuals and organizations make better decisions from stored, consumed and managed data.

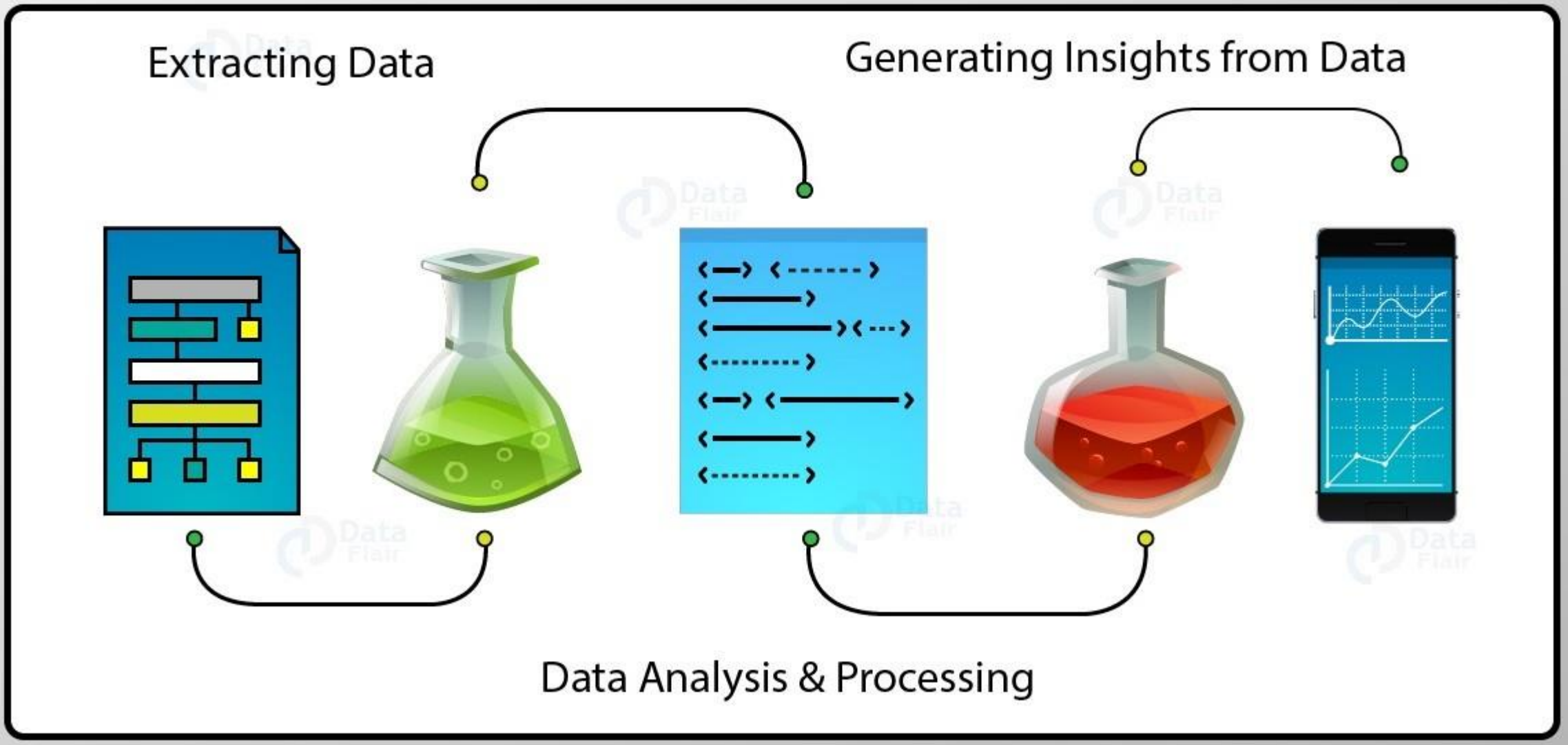
Data science is formerly known as **datalogy**.



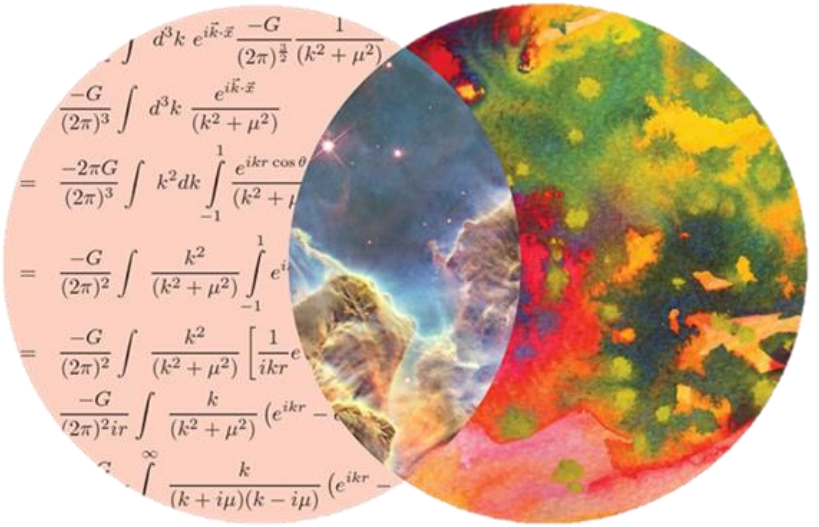
Code of conduct for Data Science - http://www.datascienceassn.org/code-of-conduct.html

A Very Short History Of Data Science - http://www.forbes.com/sites/gilpress/2013/05/28/a-very-short-history-of-data-science/#2fe9538a69fd

Purpose of Data Science



The Science of Data Science



The Art of Data Science

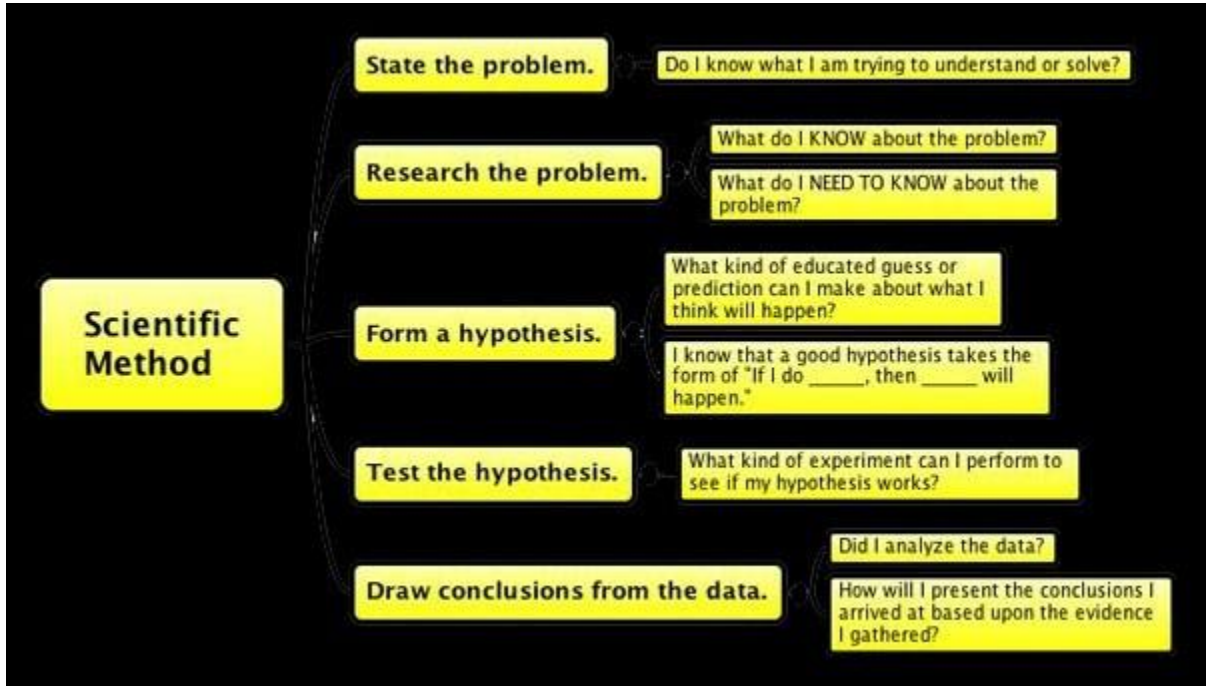
The science to extract hidden values from any data by applying scientific, statistical, mathematical and computing techniques on it.

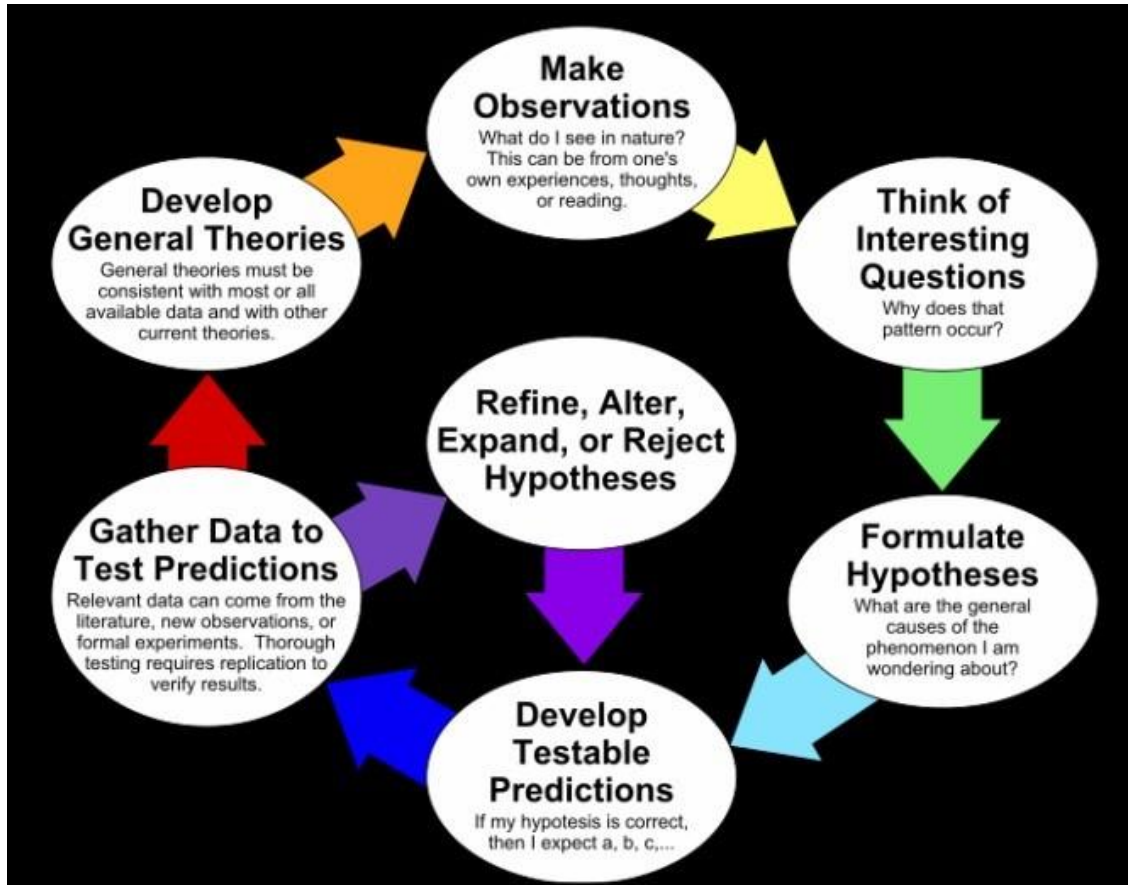
- Forming and testing hypothesis.
- Data science workflow / pipeline.
- Running data experiments to validate how certain we are of our interpretations of the results.

- Discovering what we don't know from data.
- Obtaining predictive, actionable insight from data.
- Creating Data Products that have business impact now.
- Communicating relevant business stories from data.
- Building confidence in decisions that drive business value.
- Feature Engineering
- Exploratory Data Analysis

The Science of Data Science

The **scientific method**: is a set of steps taken to ensure that conclusions are reached sensibly, experiments designed carefully, data is interpreted in accordance with the results of tests, and that procedures can be verified independently.





https://en.wikipedia.org/wiki/Scientific_method

Core Aspects of Effective Data Analysis

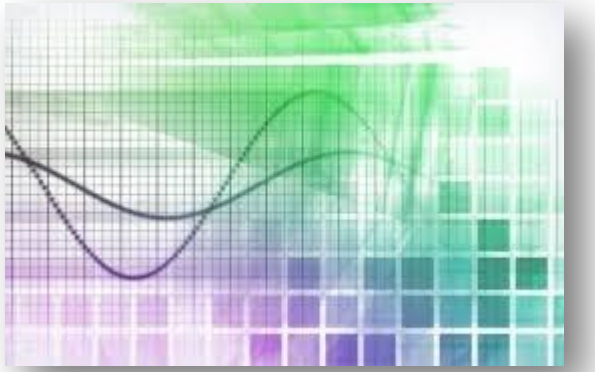
In order of difficulty: *Descriptive* → *Exploratory* → *Inferential* → *Predictive* → *Causal* → *Mechanistic*

- **Descriptive analysis** - describe set of data, interpret what you see (census, Google Ngram).
- **Exploratory analysis** - discovering connections (correlation does not = causation).
- **Inferential analysis** - use data conclusions from smaller population for the broader group.
- **Predictive analysis** - use data on one object to predict values for another (if X predicts Y, does not = X cause Y).
- **Causal analysis** - how does changing one variable affect another, using randomized studies, Strong assumptions, golden standard for statistical analysis.
- **Mechanistic analysis** - understand exact changes in variables in other variables, modeled by empirical equations (engineering/physics).

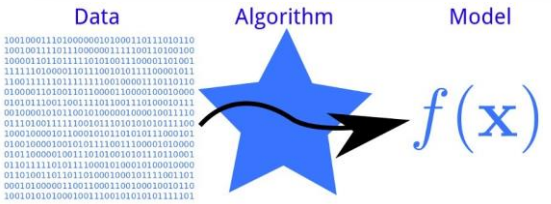
Source: Jeffery Leek https://github.com/jtleek/dataanalysis/blob/master/week1/007typesOfQuestions/index.md

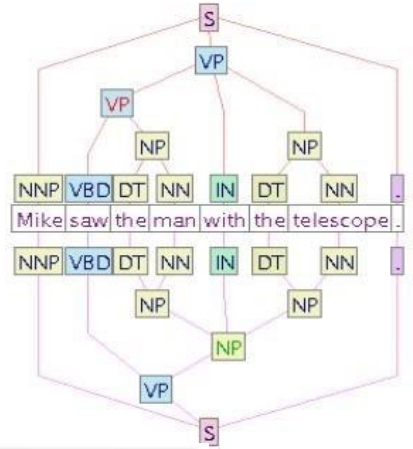
Dataset Explorer https://rpubs.com/Salimah/143370 https://salimahm.shinyapps.io/DatasetExplorer/

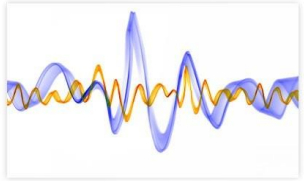
Name of Data Analysis by Data Type



- ✓ **Biostatistics** for medical data.
- ✓ **Data Science** for data from web analytics.
- ✓ **Machine Learning** for data in computer science/ computer vision.
- ✓ **Natural Language Processing** for data from texts.
- ✓ **Signal Processing** for data from electrical signals.
- ✓ **Business Analytics** for data on customers.
- ✓ **Econometrics** for economic data.

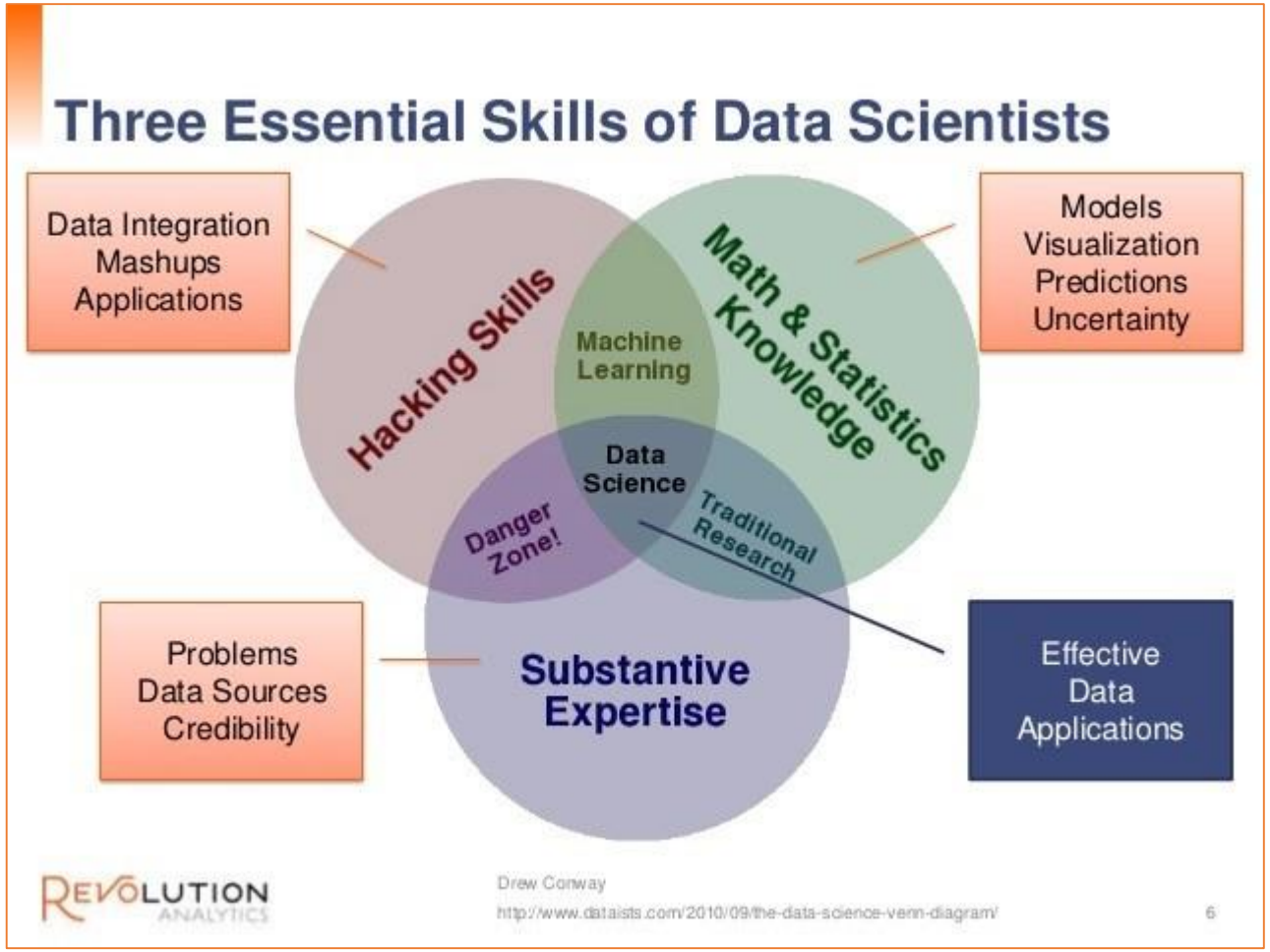






Source: Jeff Leek's Data Analysis Coursera Class

WHO is Involved?



MODERN DATA SCIENTIST

Data Scientist, the sexiest job of the 21th century, requires a mixture of multidisciplinary skills ranging from an intersection of mathematics, statistics, computer science, communication and business. Finding a data scientist is hard. Finding people who understand who a data scientist is, is equally hard. So here is a little cheat sheet on who the modern data scientist really is.

MATH & STATISTICS

- Machine learning
- Statistical modeling
- Experiment design
- Bayesian inference
- Supervised learning: decision trees, random forests, logistic regression
- Unsupervised learning: clustering, dimensionality reduction
- Optimization: gradient descent and variants

PROGRAMMING & DATABASE

- Computer science fundamentals
- Scripting language e.g. Python
- Statistical computing packages, e.g., R
- Databases: SQL and NoSQL
- Relational algebra
- Parallel databases and parallel query processing
- MapReduce concepts
- Hadoop and Hive/Pig
- Custom reducers
- Experience with xaaS like AWS

DOMAIN KNOWLEDGE & SOFT SKILLS

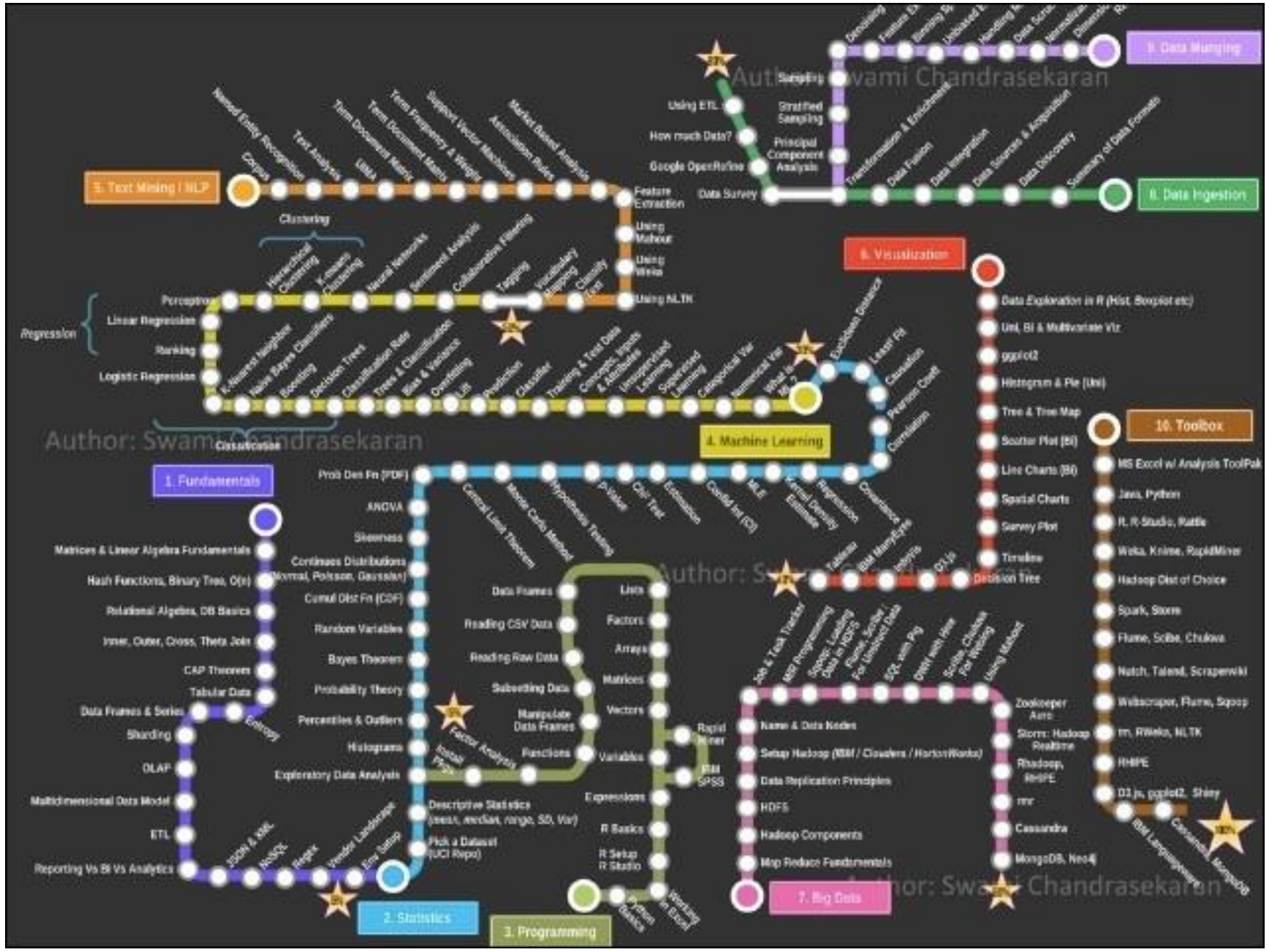
- Passionate about the business
- Curious about data
- Influence without authority
- Hacker mindset
- Problem solver
- Strategic, proactive, creative, innovative and collaborative

COMMUNICATION & VISUALIZATION

- Able to engage with senior management
- Story telling skills
- Translate data-driven insights into decisions and actions
- Visual art design
- R packages like ggplot or lattice
- Knowledge of any of visualization tools e.g. Flare, D3.js, Tableau

MarketingDistillery.com is a group of practitioners in the area of e-commerce marketing. Our fields of expertise include: marketing strategy and optimization; customer tracking and on-site analytics; predictive analytics and econometrics; data warehousing and big data systems; marketing channel insights in Paid Search, SEO, Social, CRM and brand.

Marketing DISTILLERY (c) Krzysztof Zawadzki



Curriculum via Metromap

Becoming a Data Scientist

Overall plan progressively into the following areas:

1. Fundamentals
2. Statistics
3. Programming
4. Machine Learning
5. Text Mining / Natural Language Processing
6. Data Visualization
7. Big Data
8. Data Ingestion
9. Data Munging
10. Toolbox

Source: Swami Chandrasekaran

http://nirvacana.com/thoughts/becoming-a-data-scientist/

WHERE is Data Science Used?

Healthcare
- Predict diagnosis
- Prioritize screenings
- Reduce re-admittance rates

Financial services
- Fraud Detection/prevention
- Predict underwriting risk
- New account risk screens

Retail
- Product recommendation
- Inventory management
- Price optimization

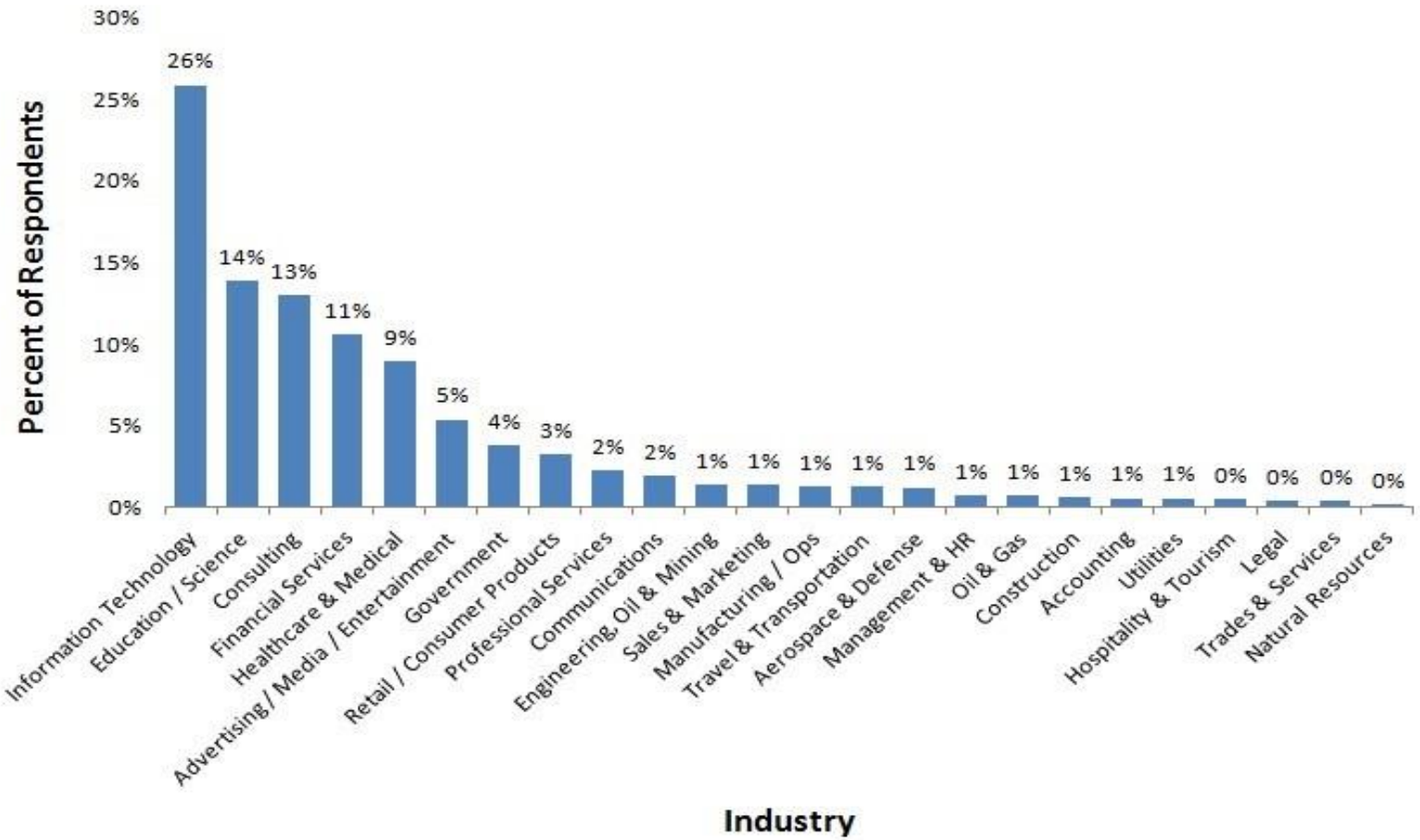
Public Sector
- Analyze public sentiment
- Optimize resource allocation
- Law enforcement & security

Telco/mobile
- Predict customer churn
- Predict equipment failure
- Customer behavior analysis

Oil & Gas
- Predictive maintenance
- Seismic data management
- Predict well production levels

Domain

Data Scientists Work in Many Industries



Data are based on over 1000 data professionals' responses to AnalyticsWeek and Business Over Broadway Data Science Survey. Due to small sample sizes (N < 20), 14 industries were not included in the chart.

WHEN is Data Science Applied?

Some examples of the outcome of data science i.e. the **data products:**

- ✓ Friend Recommendations on Facebook
- ✓ Music Recommendations on Spotify
- ✓ Product Recommendations on Amazon
- ✓ Dynamic Learning and Customized Assessments at Knewton Academy
- ✓ Trading Algorithms, Models and Credit Ratings in Finance.
- ✓ New government policies based on data.
- ✓ Predicting Flu Trends in Health
- ✓ Targeted Advertising

Applications

SOURCE: http://www.analyticsvidhya.com/blog/2015/09/applications-data-science/

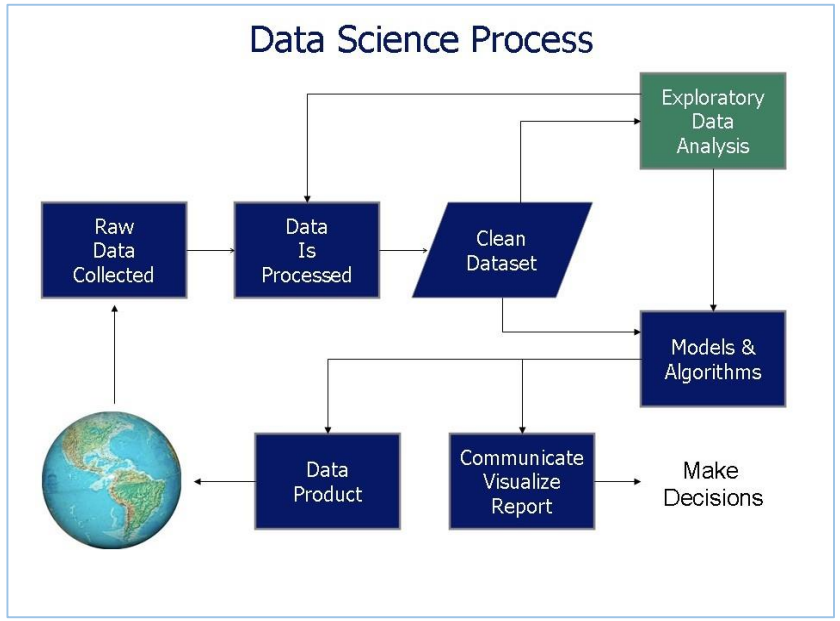
Data Jiu-Jitsu

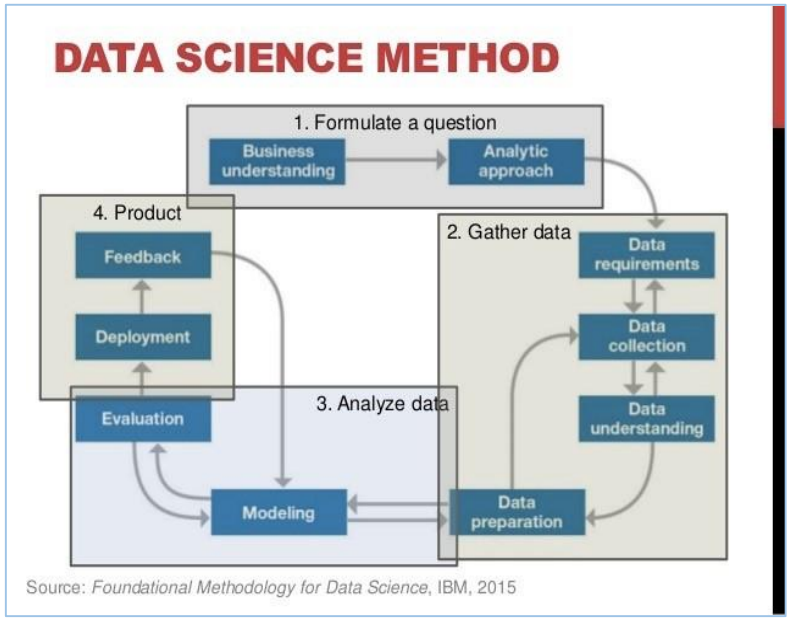
Data Jiu-Jitsu: *ability to turn big data into data products that generate immediate business value*
(DJ Patil @LinkedIn)

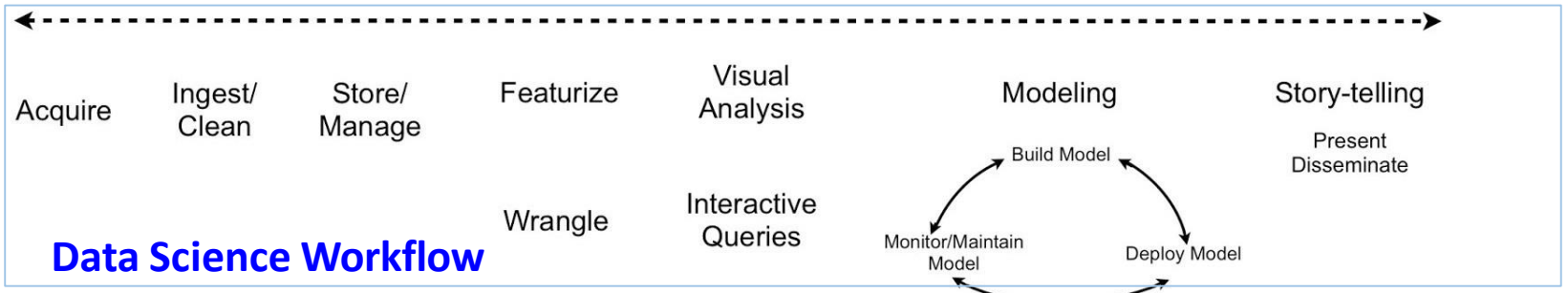
Amazon recommendations, marketing campaigns, Uber, Siri, price comparison sites, gaming and image recognition, are all powered, to varying degrees, by **data science**.

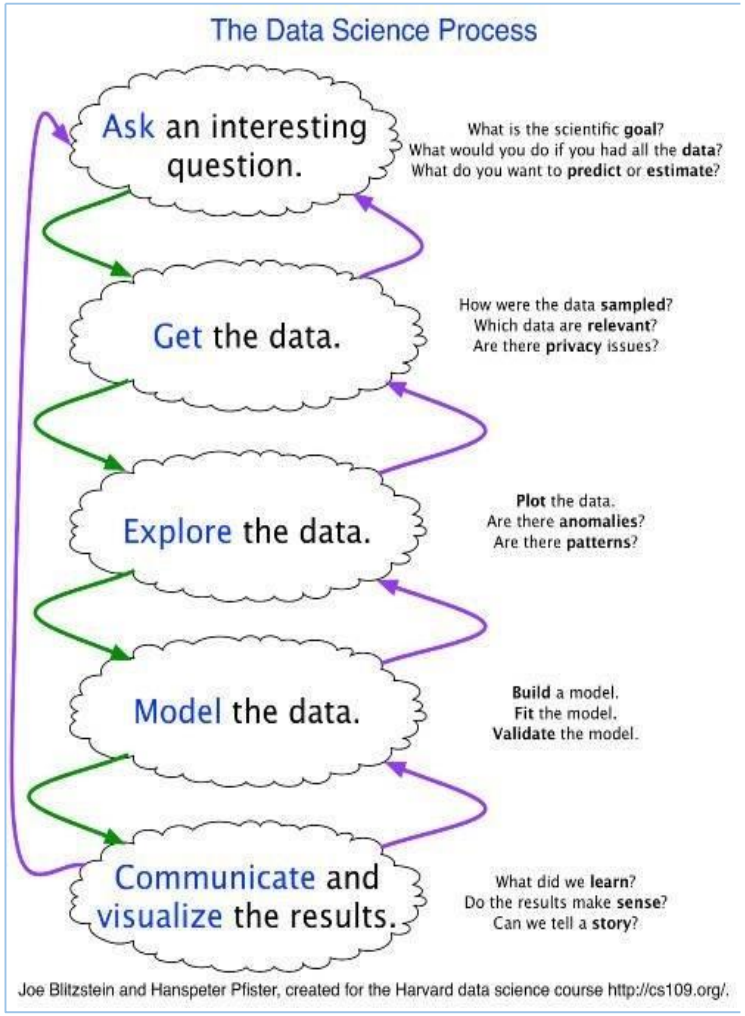
HOW Data Science Works?

Data science is a multi-step process and each step in this process requires a diverse set of skills and technologies.







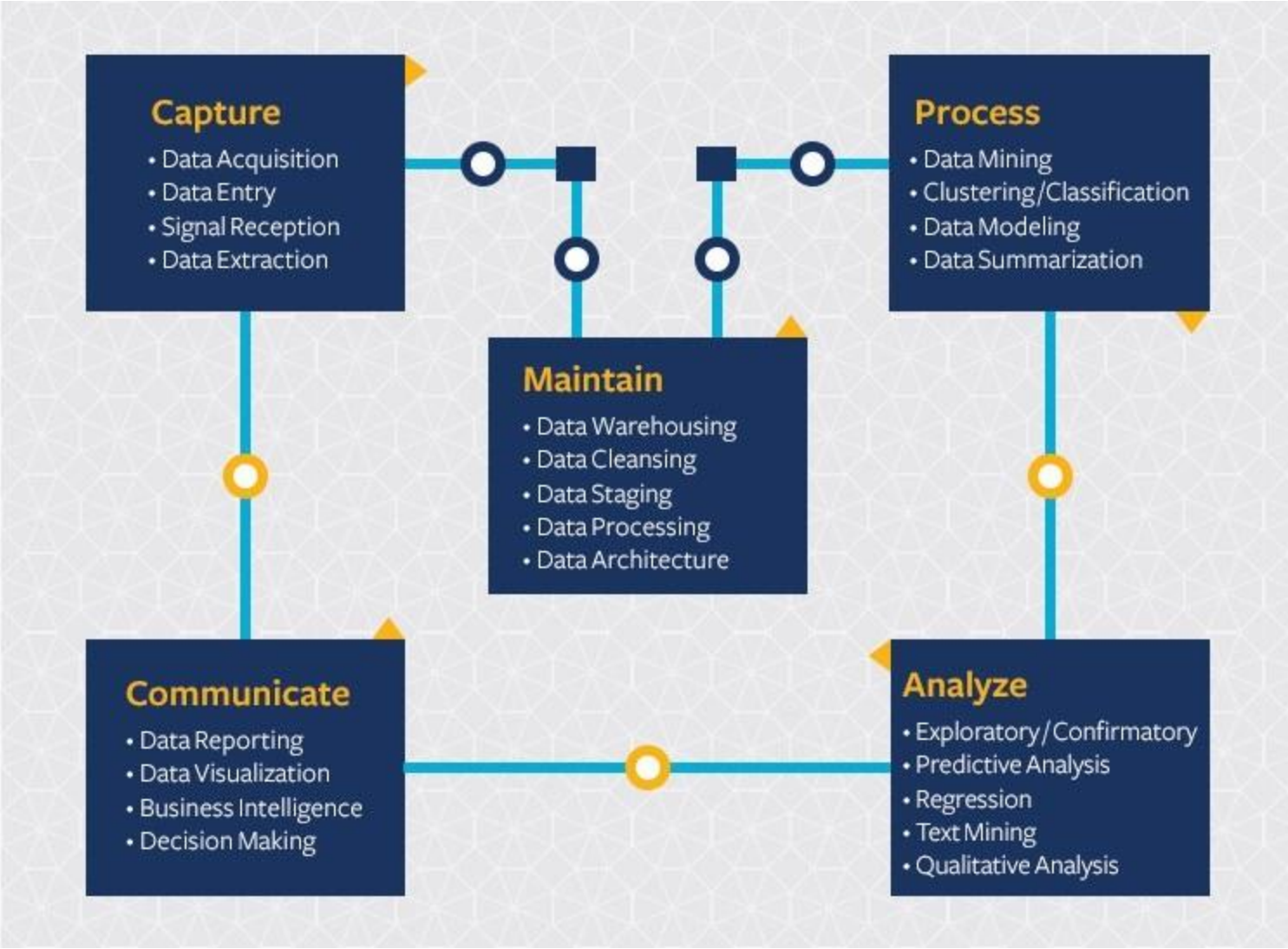


See also: https://www.edureka.co/blog/what-is-data-science/

Data Science Methodology

- **Problem Formulation** – First, identify the problem to be solved. This step is easily overlooked. However, many dollars and hours have been spent solving the wrong problems.
- **Obtain The Data** – Next, collect new data and/or gather the data that already exists. In almost all cases, this data will need to be transformed and cleansed. It is important to note that this stage does not always involve big data or a data lake.
- **Analysis** – This is the part of the process where insight is to be extracted from the data. Commonly, this step will involve creating and optimizing statistical/machine learning models for prediction, but that is not always necessary. Sometimes, the analysis only contains graphs, charts, and basic descriptions of the data.
- **Data Product** – The end goal of data science is a data product. The insight from the Analysis phase needs to be conveyed to an end user. The data product might be as simple as a slideshow; more commonly it is a website dashboard, a message, an alert, or a recommendation.

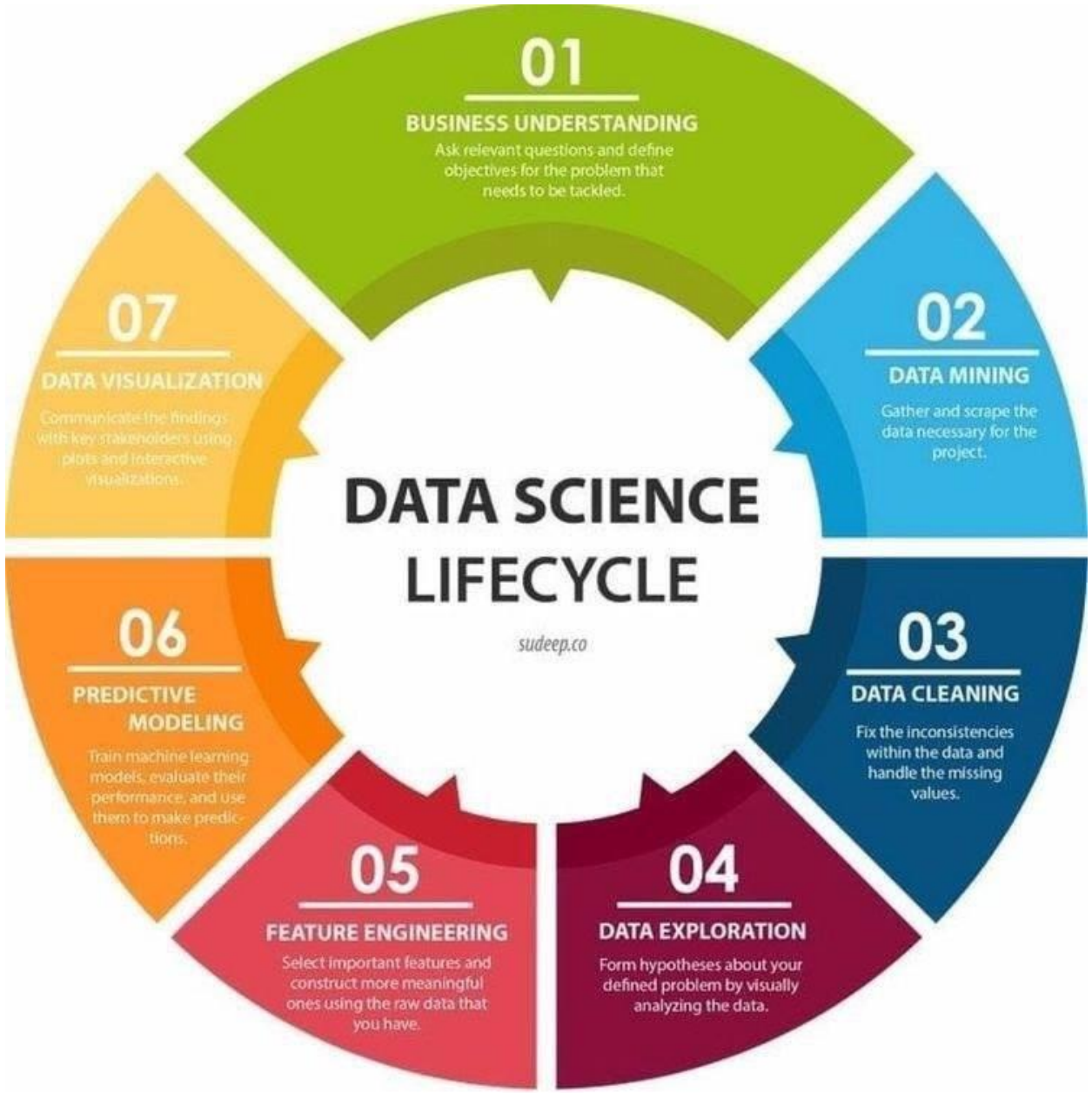
The Data Science Life Cycle

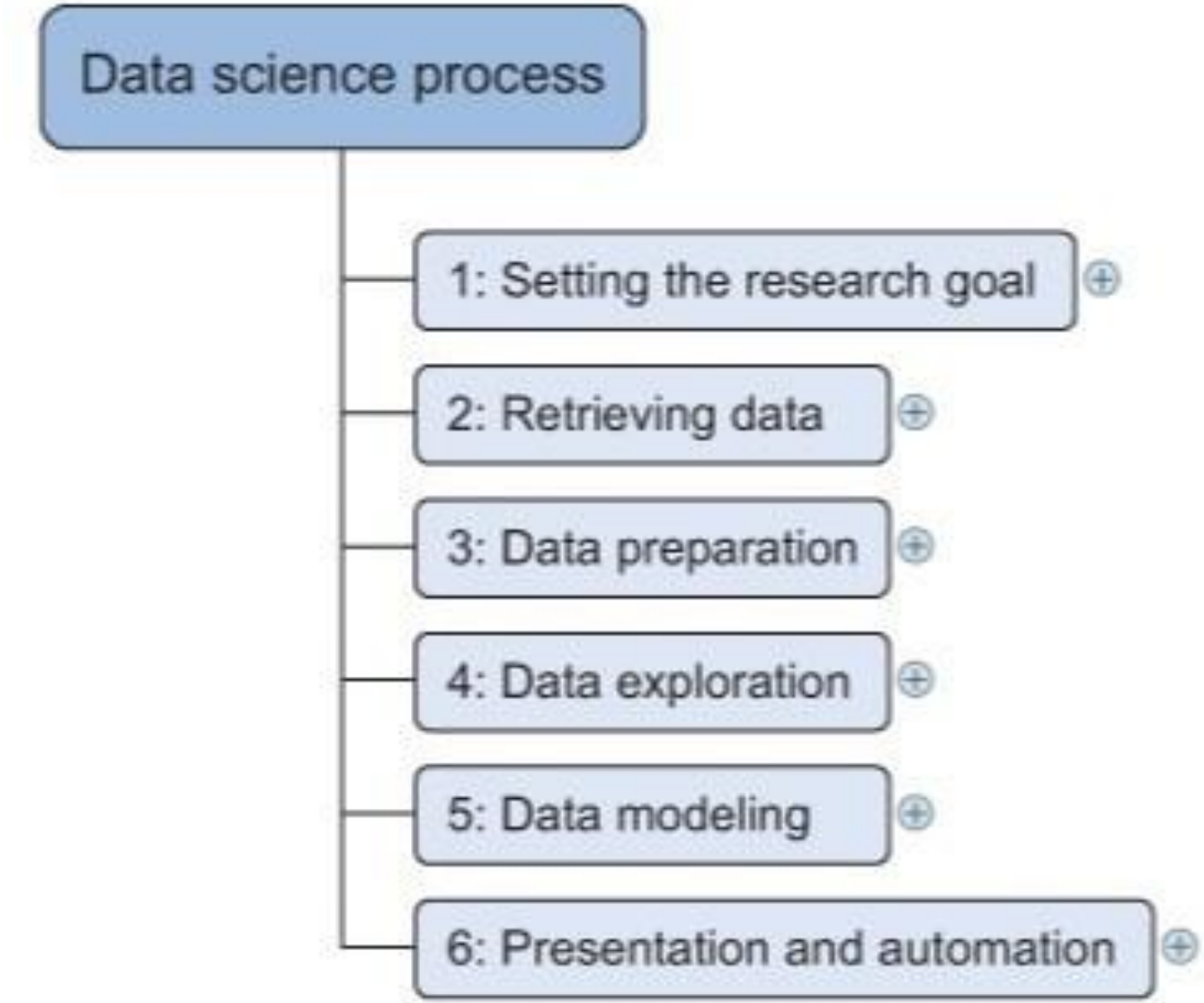


https://datascience.berkeley.edu/about/what-is-data-science/

OSEMN model

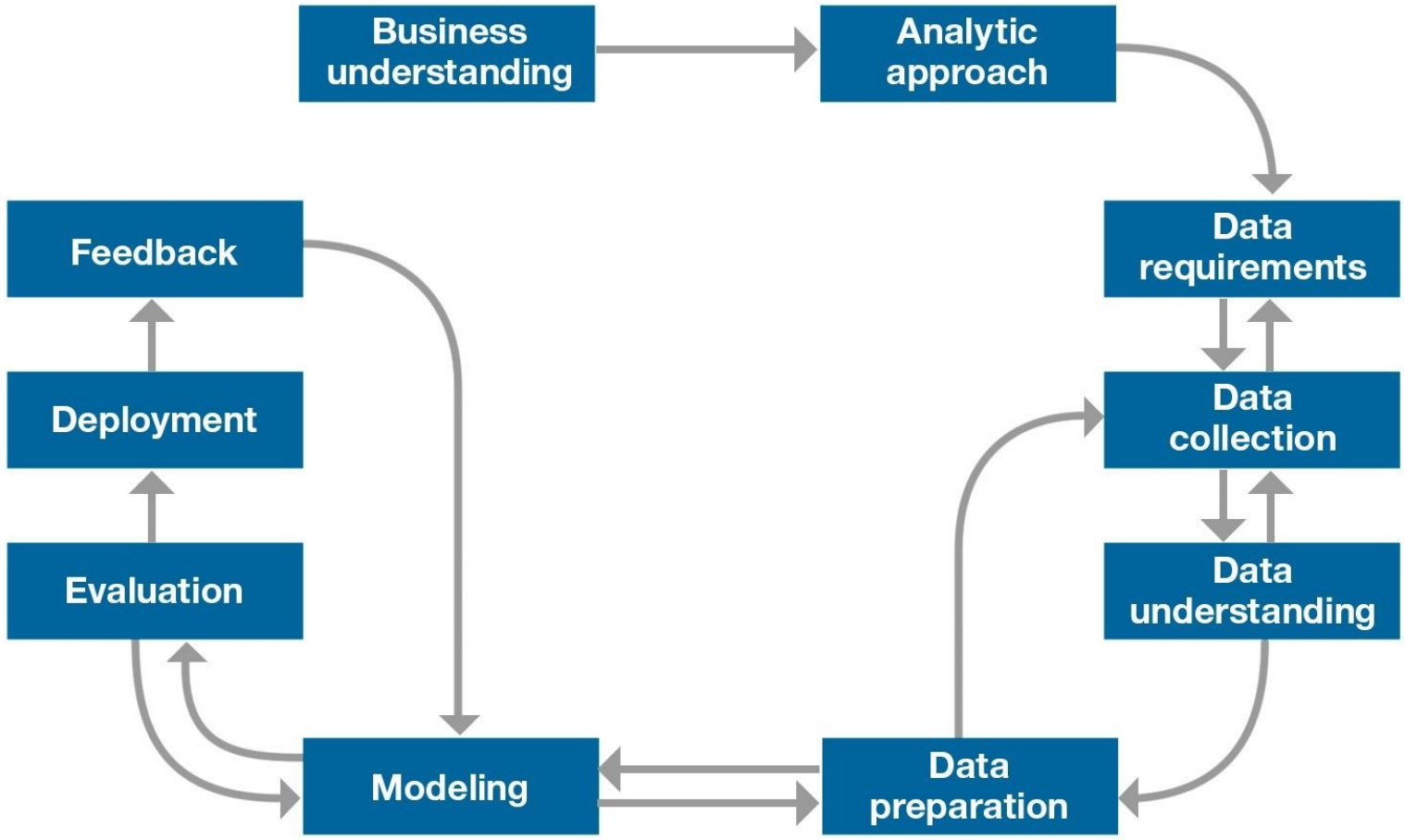
Source: A Taxonomy of Data Science





https://livebook.manning.com/book/introducing-data-science/chapter-1/60

Foundational Methodology for Data Science



- A **methodology** is a general strategy that guides the processes and activities within a given domain.
- Methodology does not depend on particular technologies or tools, nor is it a set of techniques or recipes.
- Rather, a methodology provides the data scientist with a **framework** for how to proceed with whatever methods, processes and heuristics will be used to obtain answers or results.

CRISP-DM - Cross Industry Standard Process for Data Mining

Don’t ignore domain knowledge.
Do consult a subject matter expert

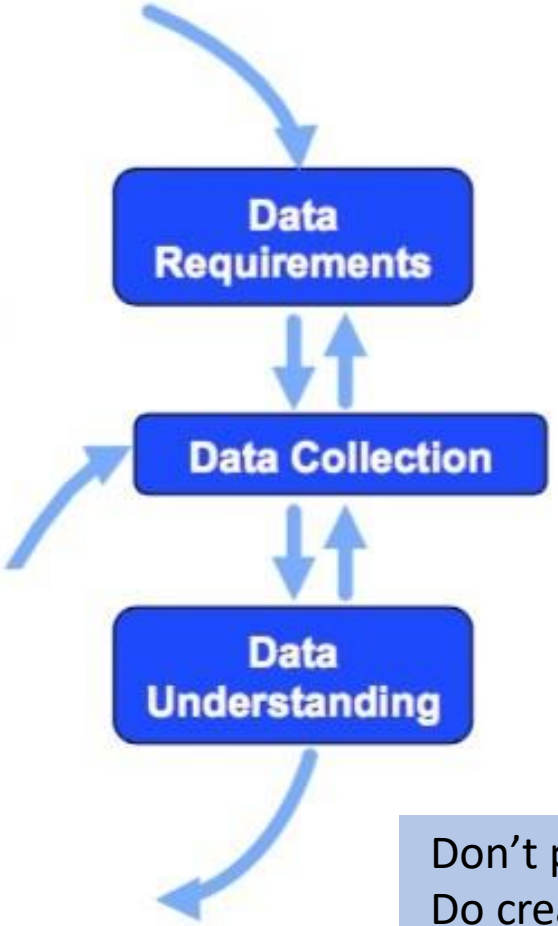
- Every project begins with **business understanding**.
  - Clearly define project objectives and requirements from the business perspective… key to a successful solution
  - Business sponsors most critical in this stage
    - Define problem and solution requirements
  - Business sponsors involved throughout the project
    - Provide domain expertise
    - Review intermediate findings
    - Ensure that the work generates the intended solution

http://101.datascience.community/2016/04/25/dos-and-donts-of-data-science/

Don’t Start with the Data!
Do Start with a Good Question.

- With a clear definition of the business problem, we define the **analytic approach** to solving the problem.
  - Express problem in context of statistical and machine learning techniques
  - Identify suitable technique(s)
  - Examples
    - *Classification* to predict response to a promotion ("yes" or "no“)
    - *Clustering* and *Associations* for customer segmentation and market basket analysis

- The chosen analytic approach determines the **data requirements**.
  - Content, formats, representations
- Initial **data collection** is performed.
  - Available data resources (structured, unstructured, semi-structured) relevant to the problem domain
  - Decide whether to obtain less-accessible data elements
  - Revise data requirements or collect more data, if needed
- Then **data understanding** is gained.
  - Descriptive statistics and visualization
  - Content, quality, initial insights about data
  - Additional data collection to fill gaps, if needed

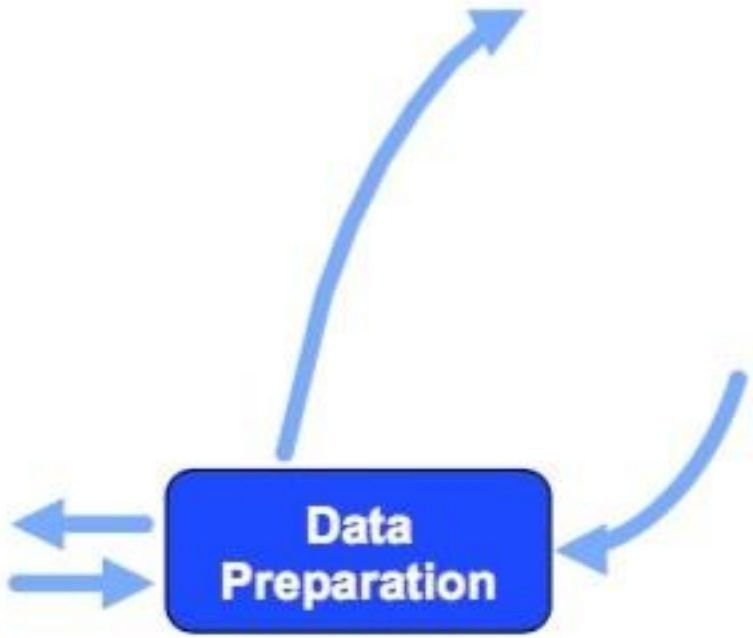


Don't brag about the size of your data.
Do collect relevant data.

Don't publish a table of numbers
Do create informative charts

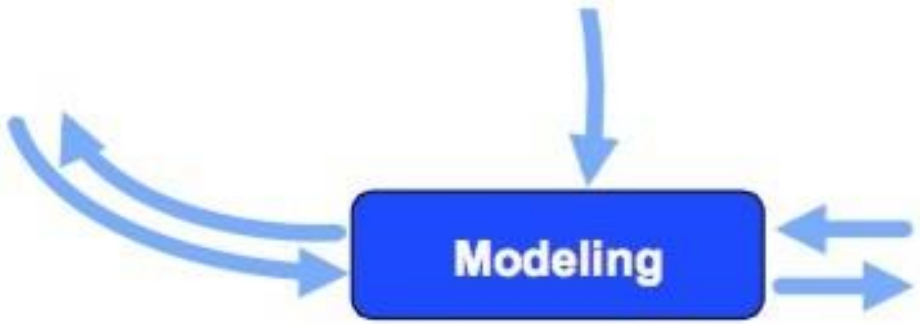
Don't use just your own data
Do enhance your analysis with open data

- **Data preparation** encompasses all activities to construct the data set.
  - Data cleaning
    - Missing or invalid values
    - Eliminating duplicate rows
    - Formatting properly
  - Combining multiple data sources
  - Transforming data
  - Feature engineering
  - Text analysis
- Accelerate data preparation by automating common steps



- **Modeling** focuses on developing models.
  - Predictive or descriptive models
  - According to the previously-defined analytic approach
  - Training set for predictive modeling

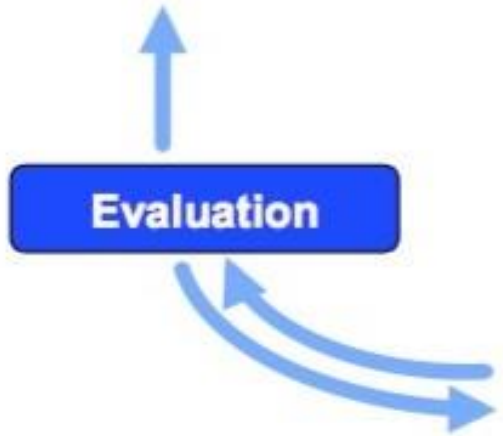
- Highly iterative process
  - Intermediate insights ➔ refinements in data preparation & model specification
  - Multiple algorithms & parameters to find best model for a given technique



- Model **evaluation** is performed during model development and before model deployment.
  - Understand the model's quality
  - Ensure that it properly addresses the business problem

- Diagnostic measures
  - Suitable to the modeling technique used
  - Testing set
  - Refine model as needed

- Statistical significance tests

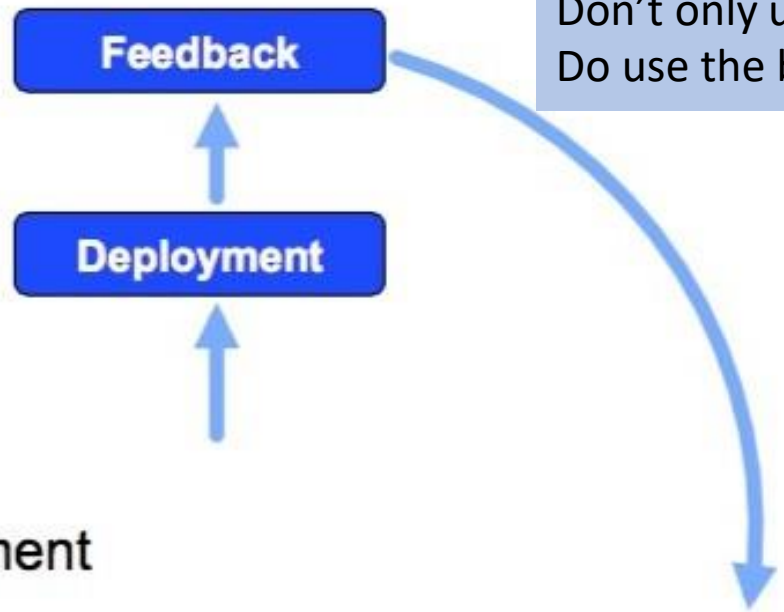


Don't always build your own tools
Do use lots of open-source tools

- Once finalized, the model is **deployed** into a production environment.
  - May be in a limited / test environment until model is proven
  - Involves additional groups, skills, and technologies
    - Solution owner
    - Marketing
    - Application developers
    - IT administration

Don't think one person can do it all
Do build a well-rounded team.

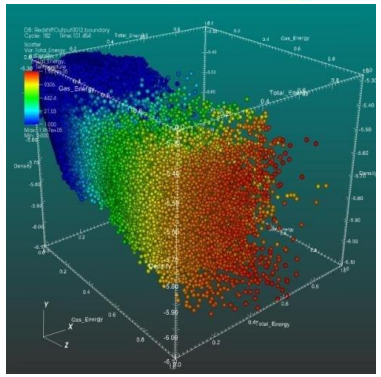
Don't only use one tool.
Do use the best tool for the job



- **Feedback** to assess model performance
  - Gathering and analysis of feedback for assessment of the model's performance and impact
  - Iterative process for model refinement and redeployment
  - Accelerate through automated processes

Don't keep all your findings to yourself.
Do share your analysis and results with the world!

The Importance of Visualization



Infographics - a great way to convey information about data.

Case Study: Target

How Target Figured Out A Teen Girl Was Pregnant Before Her Father Did

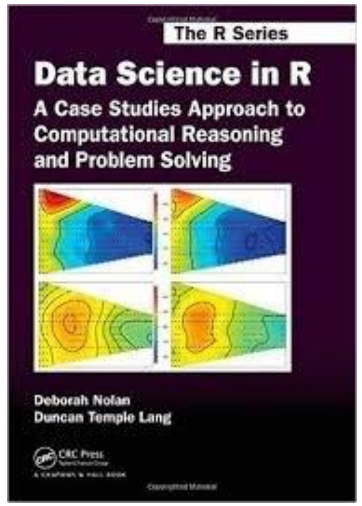
> [Pole] ran test after test, analyzing the data, and before long some useful patterns emerged. Lotions, for example. Lots of people buy lotion, but one of Pole's colleagues noticed that women on the baby registry were buying larger quantities of unscented lotion around the beginning of their second trimester. Another analyst noted that sometime in the first 20 weeks, pregnant women loaded up on supplements like calcium, magnesium and zinc. Many shoppers purchase soap and cotton balls, but when someone suddenly starts buying lots of scent-free soap and extra-big bags of cotton balls, in addition to hand sanitizers and washcloths, it signals they could be getting close to their delivery date.

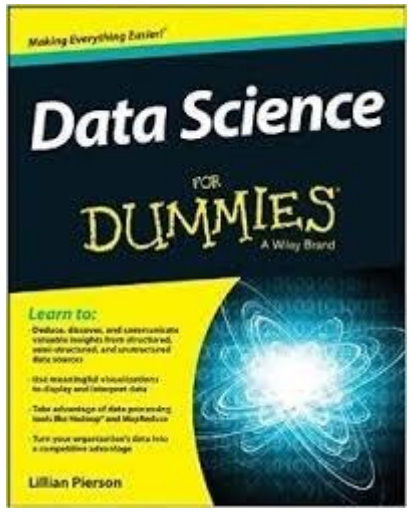
Source: http://www.forbes.com/sites/kashmirhill/2012/02/16/how-target-figured-out-a-teen-girl-waspregnant-before-her-father-did/

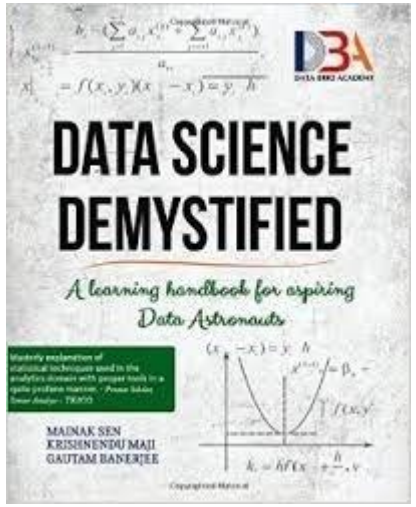
Resources

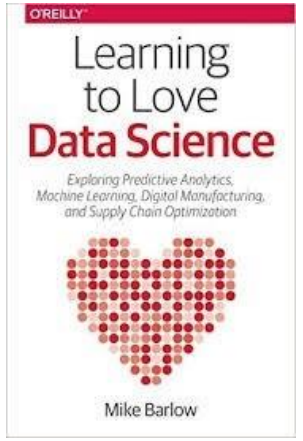
- The Open-Source Data Science Masters - http://datasciencemasters.org/
- Data Science Certificate - https://www.coursera.org/specializations/jhu-data-science
- Data Science Courses – bigdatauniversity.com
- Data Science Association – www.datascienceassn.org

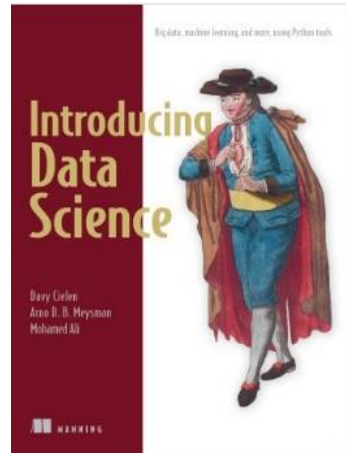
JOURNAL TITLE
EJP Data Science
CODATA Data Science Journal
Journal of Data Science Online
Big Data Journal
JDS (focuses heavily on the applications of data.)
GigaScience (focuses on life and biomedical science)

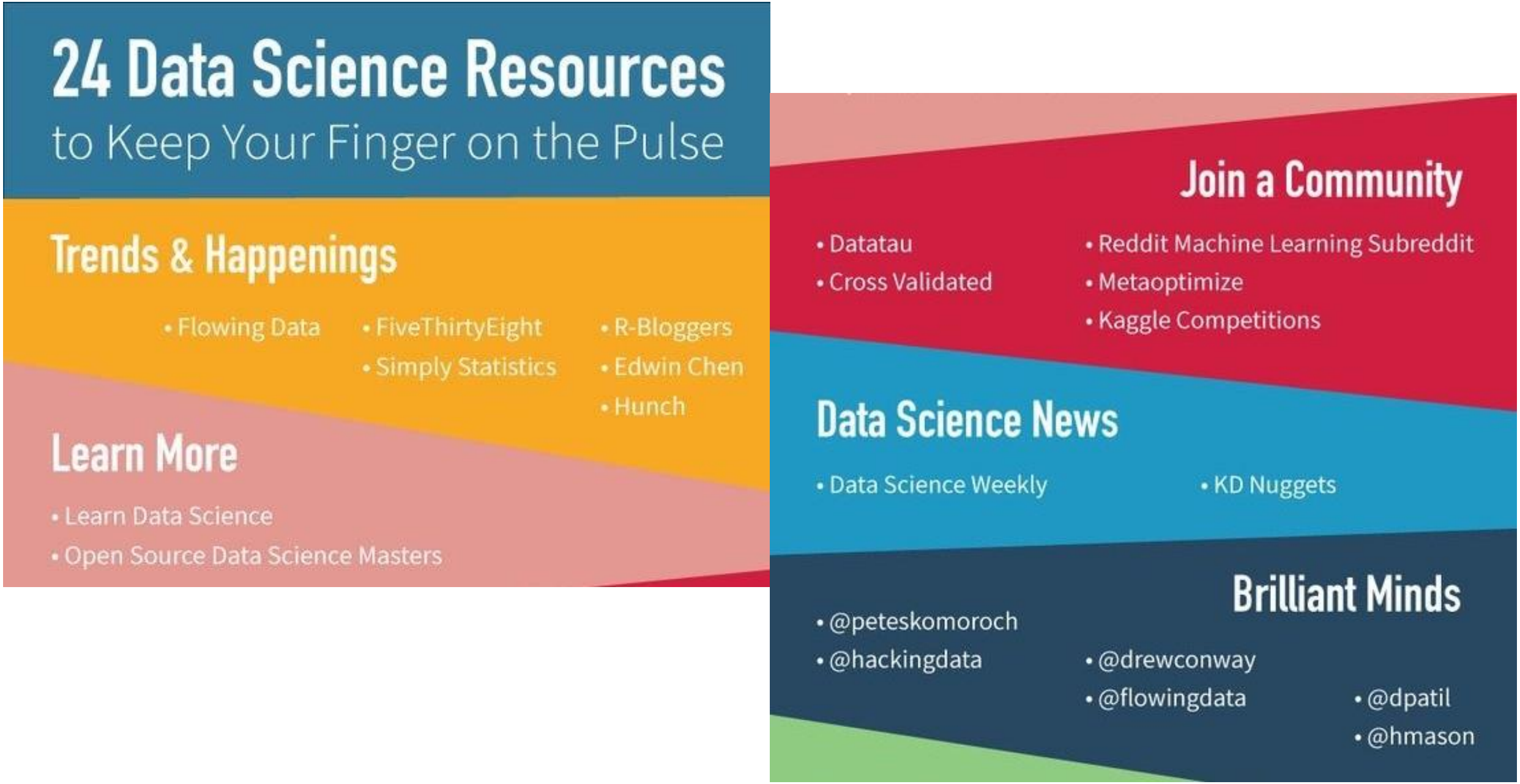






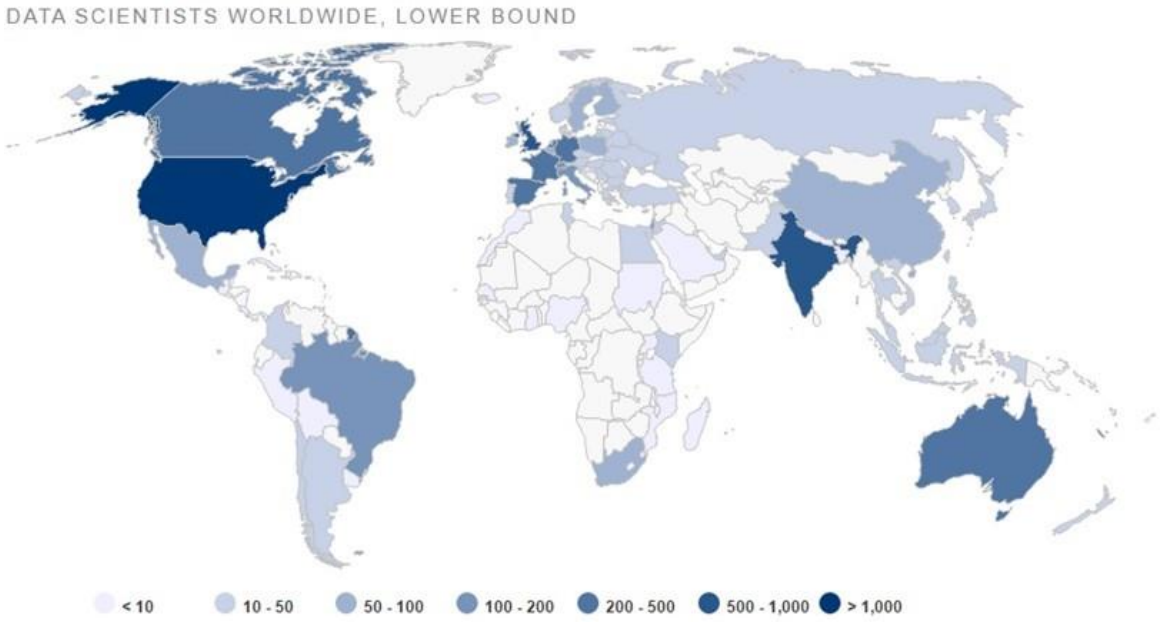






Conclusion

- Data science is a growth area. (*The number of data scientists has doubled over the last 4 years*)
- The future belongs to the companies and people that turn data into products. (The Information Technology and Services industry employs the largest number of data scientists.)
- Top skills (The top five skills listed by data scientists are: Data Analysis, R, Python, Data Mining, and Machine Learning)
- Education level (Over 79% of data scientists that list their education have earned a graduate degree, and 38% have earned a PhD.)



Source: https://rjmetrics.com/resources/reports/the-state-of-data-science/

TED TALKS

Data science for the environment | Dan Hammer | TEDxBerkeley

https://www.youtube.com/watch?v=ph439t-kTIE

Tutorial 1:
Go Ahead and Can Do Now (update your padlet's)

Own definition of data science based on own understanding

Identify famous data scientist

List domains of DS applications and examples of data products.

Rationale why data science matters today

Provide methodology, process, lifecycle, or workflow for data science