



What is Data Science?

(a personal view)

Jordi Vitrià, PhD

Machine Learning

Fat Data

Data Science

Dirty Data

Big Data

Data

Mining

Artificial Intelligence

Data Science is a **multidisciplinary methodology** to help to define what we want to do with data, how do we evaluate our algorithms, what decisions can be grounded on data, how do we combine evidences from several sources, etc.

Data Science Path

What do I want?
Does it have sense?

What are my data
sources? How reliable
are they?

How do I develop an
understanding of the
content of my data?

What are the key
relationships in my
data?

How do I develop an
understanding of the
content of my data?

What are the likely
future outcomes?

Are my expectations
fulfilled?

Question

Acquire

Describe

Discover

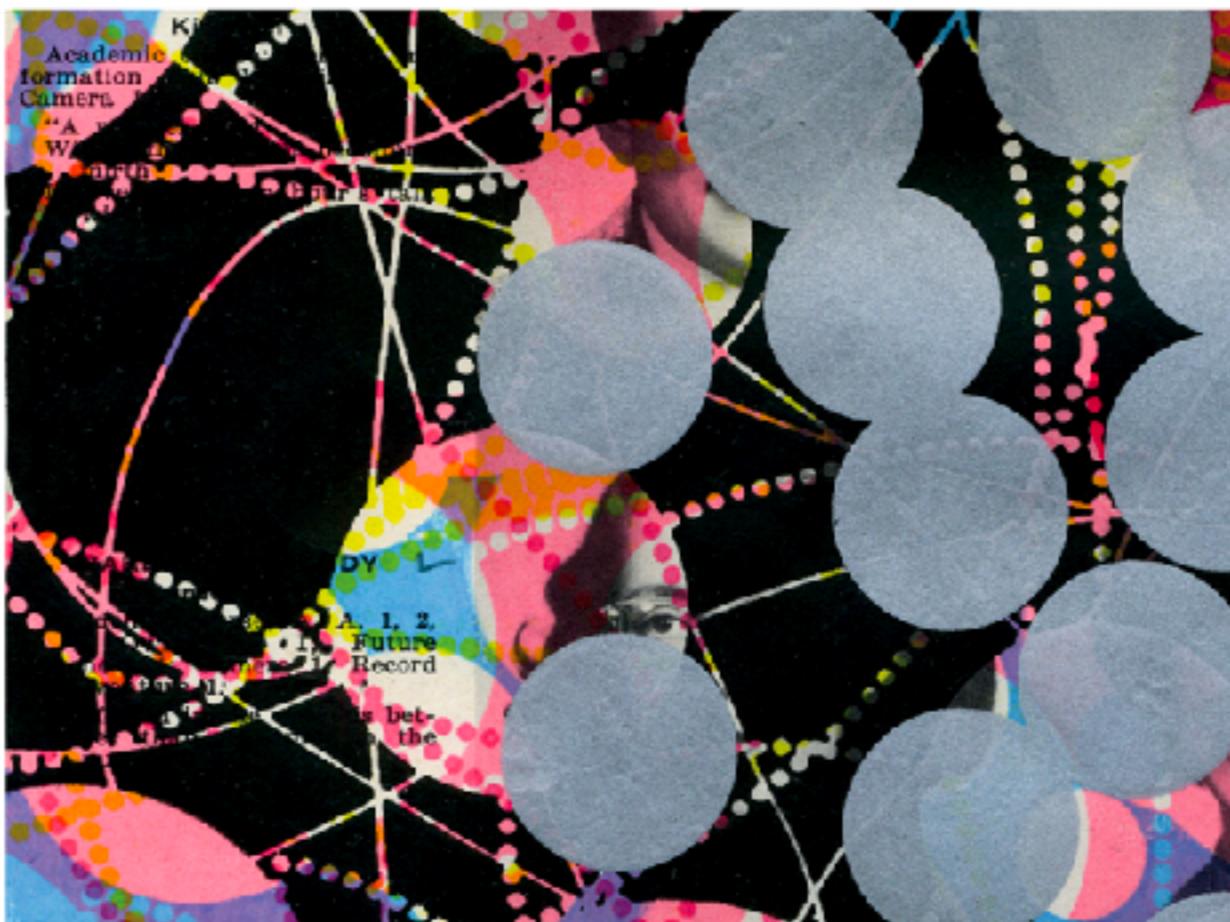
Analyze

Predict

Evaluate

In this era, where a **huge amount** of information from different fields is gathered and stored, its analysis and the **extraction of value** have become one of the most attractive tasks for companies and society in general. The design of solutions for the new questions emerged from data has required multidisciplinary teams. Computer scientists, statisticians, mathematicians, physicists, journalists and sociologists, as well as many others are now working together in order to provide **knowledge from data**. This new interdisciplinary field is called data science.

Harvard
Business
Review



DATA

Data Scientist: The Sexiest Job of the 21st Century

by Thomas H. Davenport and D.J. Patil

FROM THE OCTOBER 2010 ISSUE

Taking (big)data-based decisions is not new but now it is easier.

Sir William Davenant
@SirWilliamD

Segueix

The world before computers - staff sorting 4M used tickets from #London Underground to analyse line use in 1939.

Respon Retular Marca com a preferit Pocket Més



RETUTS 105 PREFERITS 49

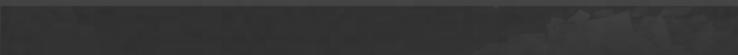
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Old Pics Archive
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Segueix

Computing Division at the Department of the Treasury, mid 1920s

RETUTS 264 PREFERITS 152

21:49 - 20 set. 2014



PROS 765 - 02:5

RETUTS 462 PREFERITS 251

STIRERIA 251 STIRERIA 251



Big Data

Big Data

What is Big Data?

- **For some people, they have big data when its size $> 65536 \times 256$.**
- **In general we have big data when its size does not allow its storage and analysis in a big computer.**

10 Megabyte Hard Disk \$3,495*



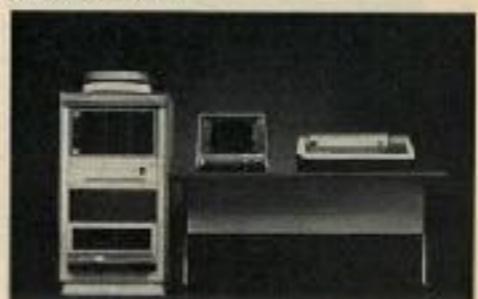
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\$4,495 for a brand new Ampex 10MB drive only.



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July 1980.

More common

Fat Data

Big Data

Less common



Big Data

With a personal computer:

- You can find an element in a 1 MB file in less than a second.
- You can find an element in a 1 GB file in less than a minute.
- You can find an element in a 1 TB file in less than sixteen hours.
- You can find an element in a 1 PB file in less than two years.
- You can find an element in a 1 EB file in less than two thousand years.

Big Data

With over 20,000 stores in 28 countries, Walmart is the largest retailer in the world. So it's fitting then that the company is in the process of building the world's largest private cloud, big enough to cope with 2.5 petabytes of data every hour. (2.5×10^{16} bits = one million gigabytes).

Big Data

- On average, people send about 500 million tweets per day.
- The average U.S. customer uses 1.8 gigabytes of data per month on his or her cell phone plan.
- Amazon sells 600 items per second.
- On average, each person who uses email receives 88 emails per day and send 34. That adds up to more than 200 billion emails each day.
- MasterCard processes 74 billion transactions per year.

Big Data

Big data is more than size.

It is commonly characterized with several V:

Volume

Velocity

Variety

Big Data

The main phenomenon behind Big Data
is **datification**.

The V's are a consequence of it.

Big Data

We are rendering into data many aspects
of the world that have never been
quantified before:

business networks books I'm reading location
physical activity consumed food purchases
physiological signals straight thoughts friendship
gaze driving behavior

Big Data

Information comes from:

- Corporate Data Bases (structured information).
- Unstructured information in documents, Wikipedia, textbooks, journals, blogs, tweets, etc.
- Images in the web, public cameras, phones, TV, YouTube, etc.
- Public APIs: smart cities, government, search engines, etc.
- Sensor Data: GPS, accelerometer, physico-chemical sensors, sociometric sensors, super-colliders, telescopes, etc.

Big Data

There are several problems:

- ETL (Extract, Transform, Load)
- BI/Analytics (Think you can do in SQL)
- **Advanced Analytics.**
- **Machine Learning.**
- Visualization.

Analyzing the past

Predicting the future

Artificial Intelligence and Machine Learning

Artificial intelligence is an academic discipline devoted to the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, language recognition, decision-making, planning, reasoning, etc.

Artificial intelligence is classified into two parts, General AI and Narrow AI. General AI refers to making machines intelligent in a wide array of activities that involve thinking and reasoning. Narrow AI, on the other hand, involves the use of artificial intelligence for a very specific task.

Machine learning is a subset of artificial intelligence that uses algorithms to learn from data (inductive behavior).

Data Science

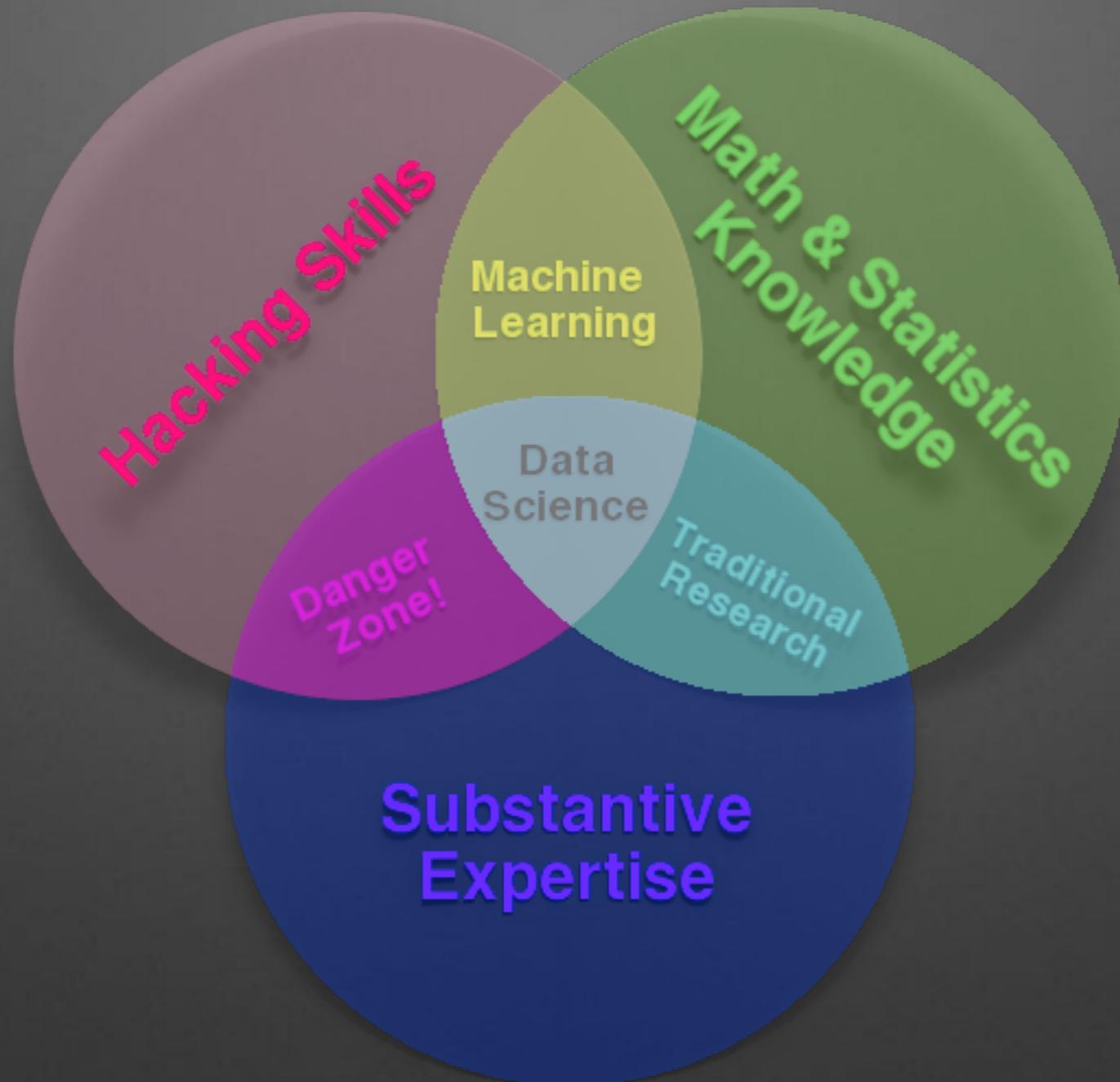
Data Science

Technology is the collection of tools, including machinery, modifications, arrangements and procedures used by humans.

Big Data is a key **technology** to process massive amounts of data (f.e. to count items).

Methodology is the systematic, theoretical analysis of the methods applied to a field of study.

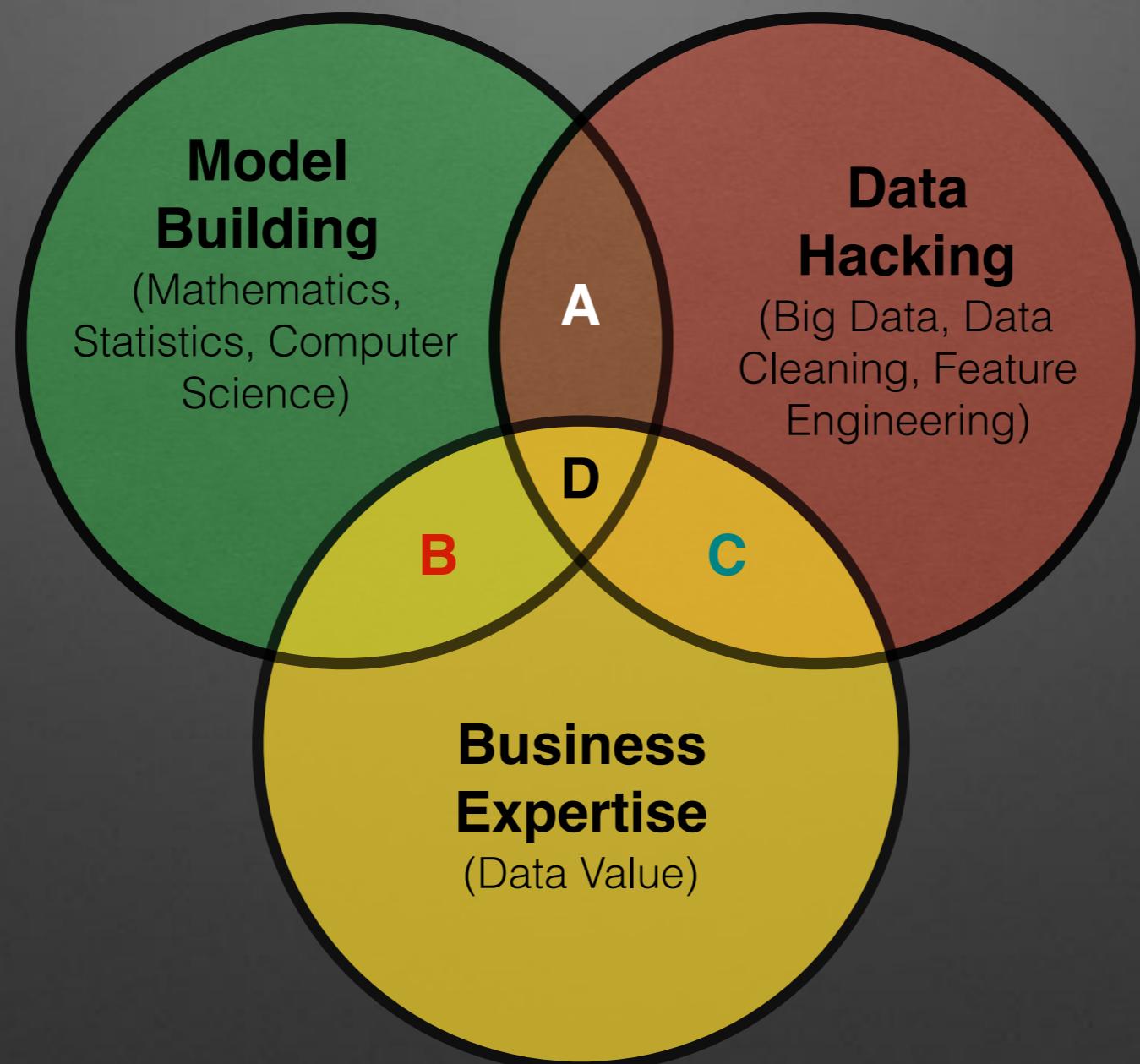
Data Science is a **methodology** to define what we want to do with data, how do we evaluate our actions, what decisions can be grounded on data, how do we combine evidences from several sources, etc.



Drew Conway's Data Science Venn Diagram

D is an empty set!

$$A + B + C = D$$



Data Science Tasks

Background

Domain Knowledge, Causality, Decision Making, Human Behavior

Domain Knowledge, Statistics, Machine Learning, Complex Systems, etc.

Data Processing,
Visualization

Data Processing

Data Engineering

Data Engineering

Output

Prescriptive Decisions:
Why? What is best?

Predictive Decisions:
How to? When to?

Data Descriptions.

Datasets

Databases

Raw Data

Knowledge

Information

Data

Data Insights:
realistic models.

Data Analysis:
experiment design, simple
models.

Data Processing: aggregation,
segmentation, labeling, metrics,
etc.

Data Preparation: cleaning, anomaly
detection, imputation, etc.

Data Storing from reliable data flow, using good
infrastructure pipelines.

Data Collection from instruments, logging, sensors, external
data, etc.

Data Science

Data Science is not a **science** but a methodology based on multidisciplinar knowledge.

Currently, most company decisions are based on intuition and best practices. The alternative is to integrate data-based knowledge in the decision process.

Data Science is a new data processing model focused on turning data into actions.

Data Science

Steps:

- Ask a question.
- Get the data. They can be heterogeneous and non structured.
- Data Processing (cleaning, munging, etc.).
- Data Analysis (computer science, linguistics, economy, sociology, etc.).
- Take a decision and act.

Data Science

Data Science is a new job!

THE SEXIEST JOB OF
THE 21TH CENTURY.
HARVARD BUSINESS REVIEW,
OCT. 2012

What are the limits of Data Science

- Data science must be bounded by ethical limits.
- Data science cannot substitute intuition or creativity.

If I had asked people what they wanted,
they would have said faster horses.
Henry Ford.

What are the limits of Data Science

- Data science models reproduce what we do and how we do it (including bad things and wrong strategies). Prediction is a dangerous game!

Rich Caruana gives the example of a pneumonia risk prediction model on which he had worked. The purpose of the model was to evaluate whether a patient with **pneumonia** was at high or low risk, to help decide whether or not the patient should be admitted to the hospital.

"On the basis of the patient data," says Caruana, "the model had found that patients with a history of **asthma** have a lower risk of dying from pneumonia. In reality, everybody knows that asthma is a very high risk factor for pneumonia. What the model found is the result of the fact that asthma patients get healthcare faster, which lowers their chance of dying compared to the general population."

Ethical Data Science

If a DS system is making automatic decisions, someone has the **responsibility** of those decisions.

Problems:

- Choosing a wrong model.
- Building a model with inadvertently discriminatory rules.
- Not providing explanations about decisions.
- Not respecting privacy.
- Etc.

Ethical Data Science

Responsible data science challenges:

- Data science **without prejudice** - How to avoid unfair conclusions even if they are true?
- Data science **without guesswork** - How to answer questions with a guaranteed level of accuracy?
- Data science that **ensures confidentiality** - How to answer questions without revealing secrets?
- Data science that **provides transparency** - How to clarify answers such that they become indisputable?

Canonical Problems and Tools

Classification	To which category does this data point belong?	Medical diagnosis: does this tissue show signs of disease? Banking: is this transaction fraudulent? Computer vision: what type of object is in this picture? Is it a person? Is it a building?
Regression	Given this input from a dataset, what is the likely value of a particular quantity?	Finance: what is the value of this stock going to be tomorrow? Housing: what would the price of this house be if it were sold today? Food quality: how many days before this strawberry is ripe? Image processing: how old is the person in this photo?
Clustering	Which data points are similar to each other?	E-commerce: which customers are exhibiting similar behaviour to each other, how do they group together? Video Streaming: what are the different types of video genres in our catalogue, and which videos are in the same genre?
Dimensionality reduction	What are the most significant features of this data and how can these be summarised?	E-commerce: what combinations of features allow us to summarise the behaviour of our customers? Molecular biology: how can scientists summarise the behaviour of all 20,000 human genes in a particular diseased tissue?
Semi-supervised learning	How can labelled and unlabelled data be combined?	Computer vision: how can object detection be developed, with only a small training data set? Drug discovery: which of the millions of possible drugs could be effective against a disease, given we have so far only tested a few?
Reinforcement learning	What actions will most effectively achieve a desired endpoint?	Robots: how can a robot move through its environment? Games: which moves were important in helping the computer win a particular game?

Data Science

	COMPANY Mastercard	INDUSTRY Finance
EMPLOYEES 67,000	TYPE Behavioral Analytics	

PURPOSE:

With 1.8 billion customers, MasterCard is in the unique position of being able to analyze the behavior of customers in not only their own stores, but also thousands of other retailers. The company teamed up with Mu Sigma to collect and analyze data on shoppers' behavior, and provide the insights it finds to other retailers in benchmarking reports.

Data Science



COMPANY

Starbucks Coffee



INDUSTRY

Food & Beverage



EMPLOYEES

160,000



TYPE

Behavioral
Analytics

PURPOSE:

Starbucks collects data on its customers' purchasing habits in order to send personalized ads and coupon offers to the consumers' mobile phones. The company also identifies trends indicating whether customers are losing interest in their product and directs offers specifically to those customers in order to regenerate interest.

Data Science



Home Smart Data Industry Solutions Hyperspectral Company Jobs

ENABLING LIVE
GEO-INFORMATION ANALYTICS

Land use classification,
climate and environmental
monitoring

Sole supplier of
high resolution
hyperspectral
data

Data Science

[HOME](#)[TEAM](#)[CAREERS](#)

Your Personal Doctor Online

OUR MISSION

Scaling the world's best healthcare to every human being

OUR APPROACH

We are using artificial intelligence / machine learning with a user-centric focus to provide instant medical expertise that is accurate, trustworthy, relevant, and actionable.

Data Science

The screenshot shows a mobile phone displaying a chat interface. The top status bar indicates the time as 9:41. The chat screen has a yellow header bar with the text "Chatnfly en linea". The message history includes:

- A welcome message from the bot: "Hello" (13:39)
- A message from the user: "Welcome back to Chatnfly! 🎉" (13:39)
- A message from the bot: "USE: TEXT 📲, VOICE MESSAGES🎤 or fill in the FORMS by clicking ✍️ the button below." (13:39)
- A message from the user: "Search: <https://goo.gl/nnoLUT>" (13:39)
- A message from the user: "I want to book a room in a 4 star hotel in New York from the April 5th until the April 7th" (13:40)
- A message from the bot: "I'm looking for your best options! Please bear with me, you will have your results very soon." (13:41)

To the right of the phone, there is promotional text: "Book your flight and hotel through our app. Download it!" followed by "Play Store" and "App Store" download buttons. A blue button at the bottom right says "Puedes probarnos en nuestro chat web!".

correYvuela

How it works FAQs SAAS Contact Language:

Data Science

The image shows the homepage of the Social Point website. At the top, there's a navigation bar with the "socialpoint" logo, a search icon, and links for HOME, GAMES, JOBS, ABOUT, BLOG, PRESS, and COMMUNITY.

The main banner features the game "Monster Legends" with its logo and a colorful illustration of various monsters. It includes download links for Facebook, App Store, and Google Play.

On the left side, there's a section titled "DISCOVER WHO WE ARE AT SOCIAL POINT!" which includes a video player showing people working in an office and a graphic of four stylized human figures (red, blue, green, yellow) sitting at desks.

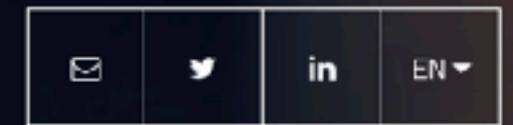
On the right side, there's a "WE'RE HIRING" section with a quote from Alba Rodriguez: "We share what we learn and we learn from each other." It features a photo of a woman holding a bowl of fruit and a "CHECK OUT ALL JOBS" button.

At the bottom left, there are social media icons for LinkedIn, YouTube, and GitHub.

Text on the page includes:
Discover who we are at Social Point!
OUR OFFICES ARE BECOMING MORE AND MORE HEALTHY AND ECO-FRIENDLY EVERY DAY
"We share what we learn and we learn from each other."
Alba Rodriguez
Head of Influencer Marketing
CHECK OUT ALL JOBS

Data Science

Kernel
analytics



Analytics at the core

Data helps businesses make better decisions.
We help businesses make the most of their data.

Want to know more about us?

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Want to work at Kernel Analytics?

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Data Science

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Data Scientist Jobs in Barcelona 95 Jobs

Data Scientist
Social Point - Barcelona 21 days ago
 models that can be embedded in our ongoing data processes, working closely with Data Engineers and Tooling Developers - Debugging... people to join our teams. About the role: As part of our Data Science team you will be working to apply scientific models to...

Data Scientist
Chartboost - Spain
 We're seeking a superb data scientist to build and evolve our monetization models for both the demand (advertisors) and supply... failures and successes backed by data. Define, advocate and maintain high standards for data quality. Who you are: 3-5...

Data Analyst
TravelPerk - Barcelona
 relevant experience interpreting data in a business intelligence, analytics, or data science/data scientist role, including relevant tools... Management with visual data

Data Scientist
3.9 ★ Social Point - Barcelona, ES

[Job](#) [Company](#) [Rating](#) [Reviews](#)

About us:
We are a rapidly growing social game developer, with top ranked games on Mobile and Facebook.
We have over 50 million fans worldwide playing our games all over the world.
There are about 350 of us creating super fun games in our offices, located 10 minutes from the beach, in the beautiful and sunny Barcelona.
Last year we were acquired by Take Two Interactive (GTA, Bioshock, XCOM) and have been expanding our activities, creating exciting new opportunities for top people to join our teams.

About the role:

Conclusions

- **Big Data** will be soon a commodity that will be used mainly for data munging and counting at scale.
- The most difficult part of **Big Data is Data**.
- **Data Science** is a new job that is here to stay.

**Data Science is for all,
small and big, old and new, etc.**



Swimming companies

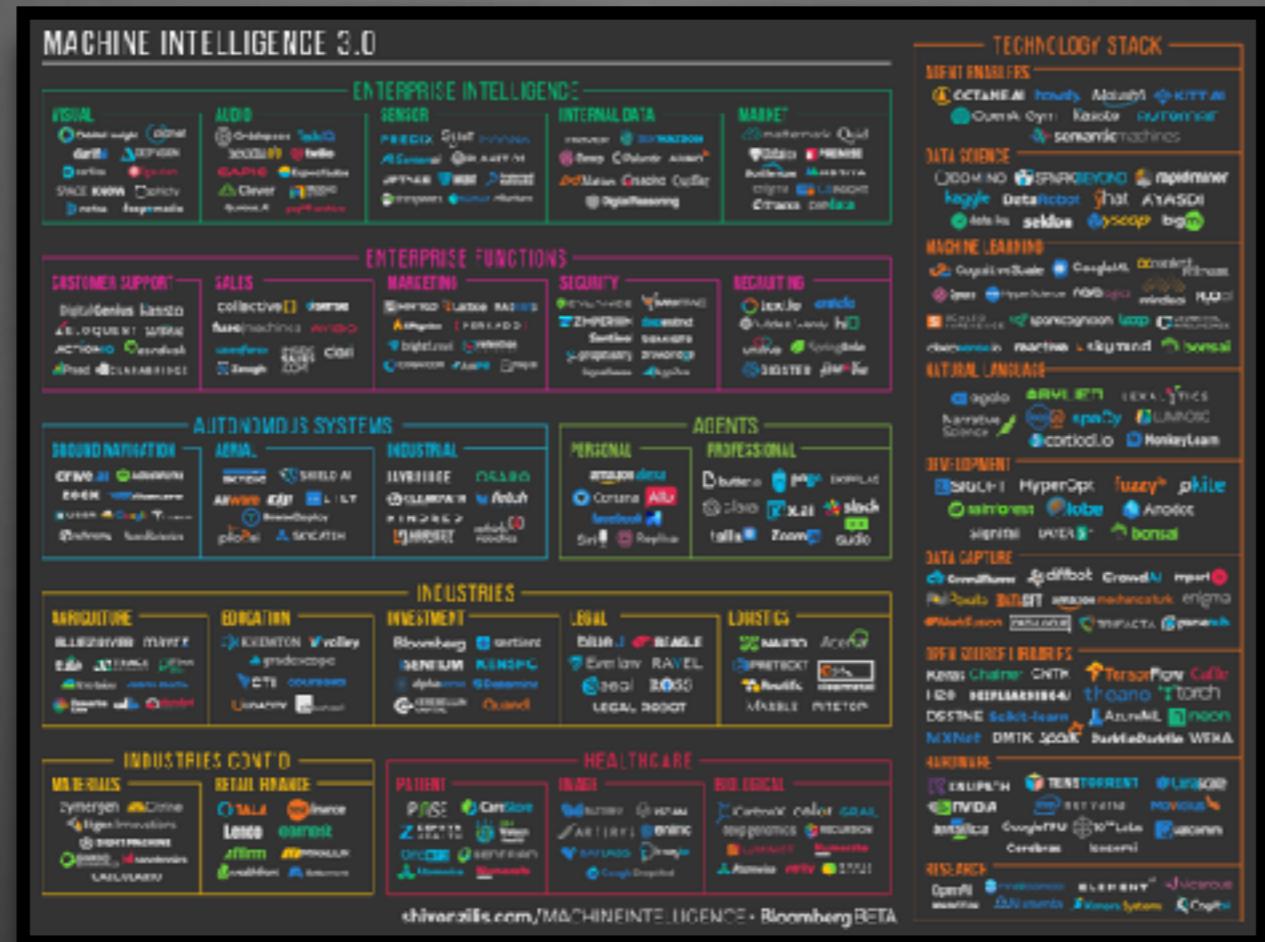
Walking companies



Running companies

**Data Science is for all,
small and big, old and new, etc.**

All these companies can be better by
knowing better their **customers**,
improving by their operational **processes**
and even by creating new **business**
models with data products.



Datification is not the only ingredient of the data science revolution. The other ingredient is the **democratization** of data analysis.