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Adjunct Professor, University of Toronto

MIE1624H – Introduction to Data Science and Analytics Lecture 1 – Introduction

About me

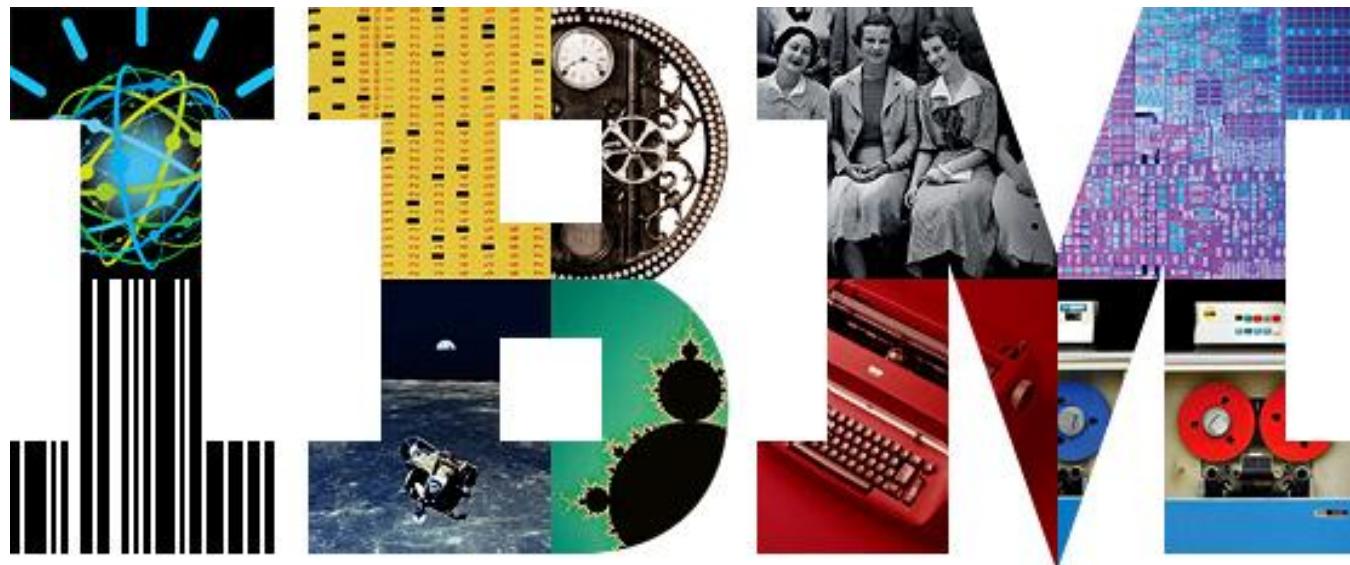
Dr. Oleksandr Romanko

- Senior Research Analyst, Quantitative Research at Risk Analytics, Business Analytics, IBM, with the company since 2010
- Ph.D. in Computer Science from McMaster University
- Author of over 20 papers and reports
- Adjunct professor at University of Toronto and lecturer at McMaster University
- Research areas:
 - business analytics, operational research, optimization, finance
 - portfolio optimization, multi-objective optimization
 - market and credit risk modeling and optimization
 - numerical methods for risk management
 - design of numerical algorithms and their software implementation

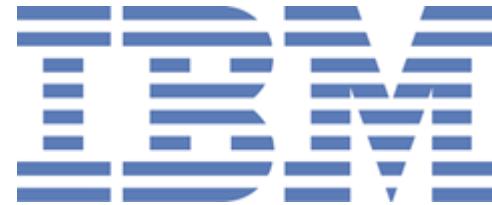




Being an IBMer



IBM Centennial: A Century of Progress



2011



1911

Incorporated on June 16, 1911 in US as the
Computing Tabulating Recording Company

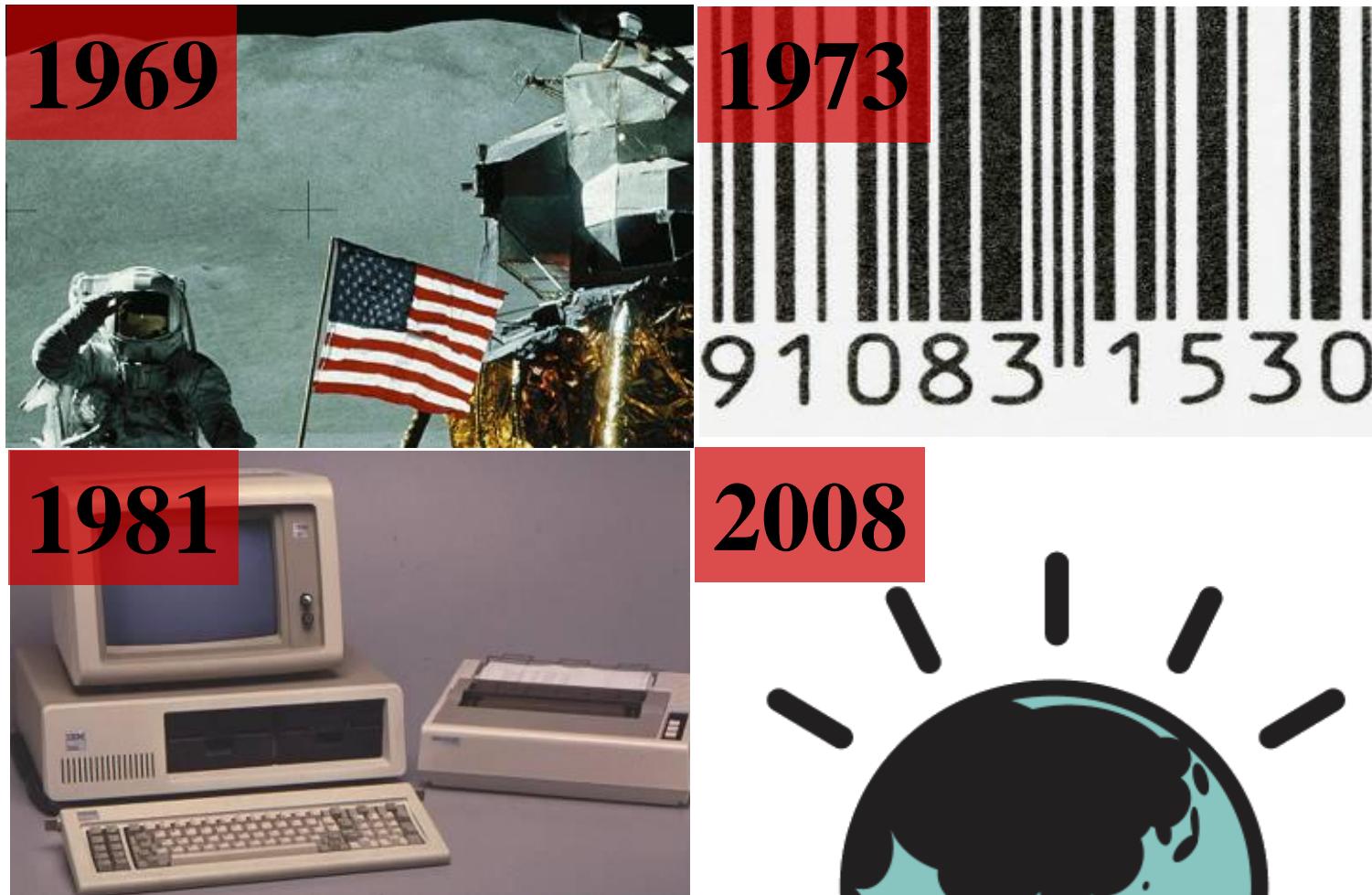
CTR changed its name to International
Business Machines Corporation
globally in 1924

CTR changes name in Canada to International
Business Machines Company in 1917



COMPUTING-TABULATING-RECORDING CO.

Making the world work better – pioneering the science

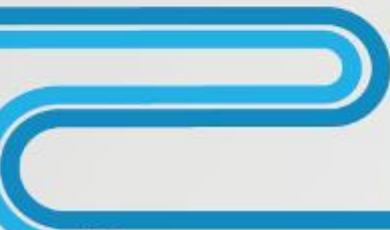


IBM Centennial: 100 Years of Innovation



A Snapshot of IBM Milestones

This June, IBM will reach a significant milestone—its 100th anniversary. Join us in taking a look back at just a few of the historical breakthroughs that have helped IBM shape the century and the company.



1900



IBM was formed as the Computing Tabulating and Recording Company, or C-T-R, specializing in punch cards, commercial scales and clocks.



With global ambitions, the company renamed itself International Business Machines – today, it operates in 170 countries.



IBM worked with the U.S. government to start Social Security – the largest accounting project of its time.

1923



IBM's punched card technology helped tackle large-scale projects like the U.S. Census.

1935



IBM pioneered training courses for women so they could work in technical positions traditionally filled by men.

1956



RAMAC (Random Access Method of Accounting and Control), the first magnetic hard disk drive, created the data storage industry.

1961



The Selectric Typewriter was an instant design sensation, delighting typists for 26 years.

1969



IBM technology guided the Apollo mission to the moon – the company has played a part in the U.S. space program since the 1960s.

1980



IBM was granted the first patent for LASIK surgery technology – and continues to hold more U.S. patents than any company.

1997



IBM's Deep Blue supercomputer defeated the best chess player in the world.

2011



Watson supercomputer can detect nuances in words, irony and wit – and inspire new realms of search queries and artificial intelligence.

1900

1930

1960

1980

2011

1924



With global ambitions, the company renamed itself International Business Machines – today, it operates in 170 countries.

1944



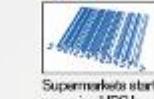
IBM's 604 Electronic Sequence Controlled Calculator was the first machine to handle long calculations automatically.

1964



The company made a big bet with the System/360 – this early mainframe ushered in the era of computer compatibility.

1973



Supermarkets started scanning UPC bar codes, invented by IBM. Today, they track everything from clothing to dairy cows.

1986



IBM scientists won the Nobel Prize for the scanning tunnel microscope – which would eventually manipulate atoms to spell I-B-M.

1997



IBM launched "eBusiness," turning the Internet into a tool for business and ushering in the future of electronic commerce.

1962



IBM and American Airlines launched the world's first computer-driven airline reservation system, SABRE – which paved the way for online banking technology.

1969



IBM labs developed the magnetic strips on credit cards – still ubiquitous on ID cards, drivers' licenses and ATM bank cards.

1981



The IBM Personal Computer launched the PC revolution, helping computers go mainstream beyond hobbyists and geeks.

2008



Smarter Planet launched to improve how the world works – now smart buoys in Ireland's Galway Bay detect pollution, protect fish stock.



Best Jobs

Profession



«Choose a **job you love**,
and you will never have to
work a day in your life.»

Confucius

«The only way to do great work is to
love what you do. If you haven't found
it yet, **keep looking**. Don't settle.»

Steve Jobs



Best jobs

Forbes / Tech / #BigData

FEB 25, 2016 @ 11:26 PM 14,811 VIEWS

Is Being A Data Scientist Really The Best Job In America?



Bernard Marr, CONTRIBUTOR

I write about big data, analytics and enterprise performance [FULL BIO](#)

Opinions expressed by Forbes Contributors are their own.

It's official – data scientist is the best job in America, according to users of online employment analysts Glassdoor.

Glassdoor's service allows employees to anonymously rate their jobs and their employers, awarding scores for how well they are paid, treated, and helped to advance in their careers.

 glassdoor

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Interviews

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25 Best Jobs in America

Want a new job? Glassdoor is here to help, identifying the 25 Best Jobs in America for 2016. The jobs that make this list have the highest overall Glassdoor Job Score, determined by combining three key factors – number of job openings, salary and career opportunities rating. These jobs stand out across all three categories.

United States  2016 

1		Data Scientist	1,736
		Job Openings	\$116,840
		Median Base Salary	4.1
		Career Opportunity	4.7
		Job Score	
2		Tax Manager	1,574
		Job Openings	\$108,000
		Median Base Salary	3.9
		Career Opportunity	4.7
		Job Score	

Big Data's Big Problem: Little Talent



Forbes
TECH | 1/18/2013 @ 10:18AM | 9,232 views
Combating the Big Data skills shortage

THE CHRONICLE OF HIGHER EDUCATION

November 14, 2013

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Administration

August 14, 2013

IBM and Universities Team Up to Close a 'Big Data' Skills Gap



The Big Data & Analytics Hub

Blogs Videos & Podcasts Resources Events Around the Web IBM Solutions

Data Scientist: Closing the Talent Gap

January 17, 2013

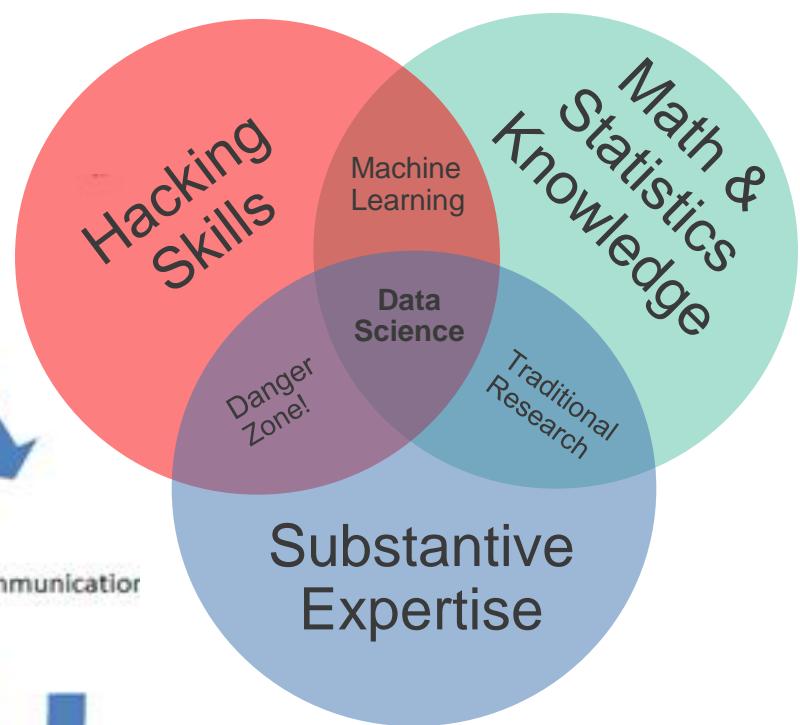
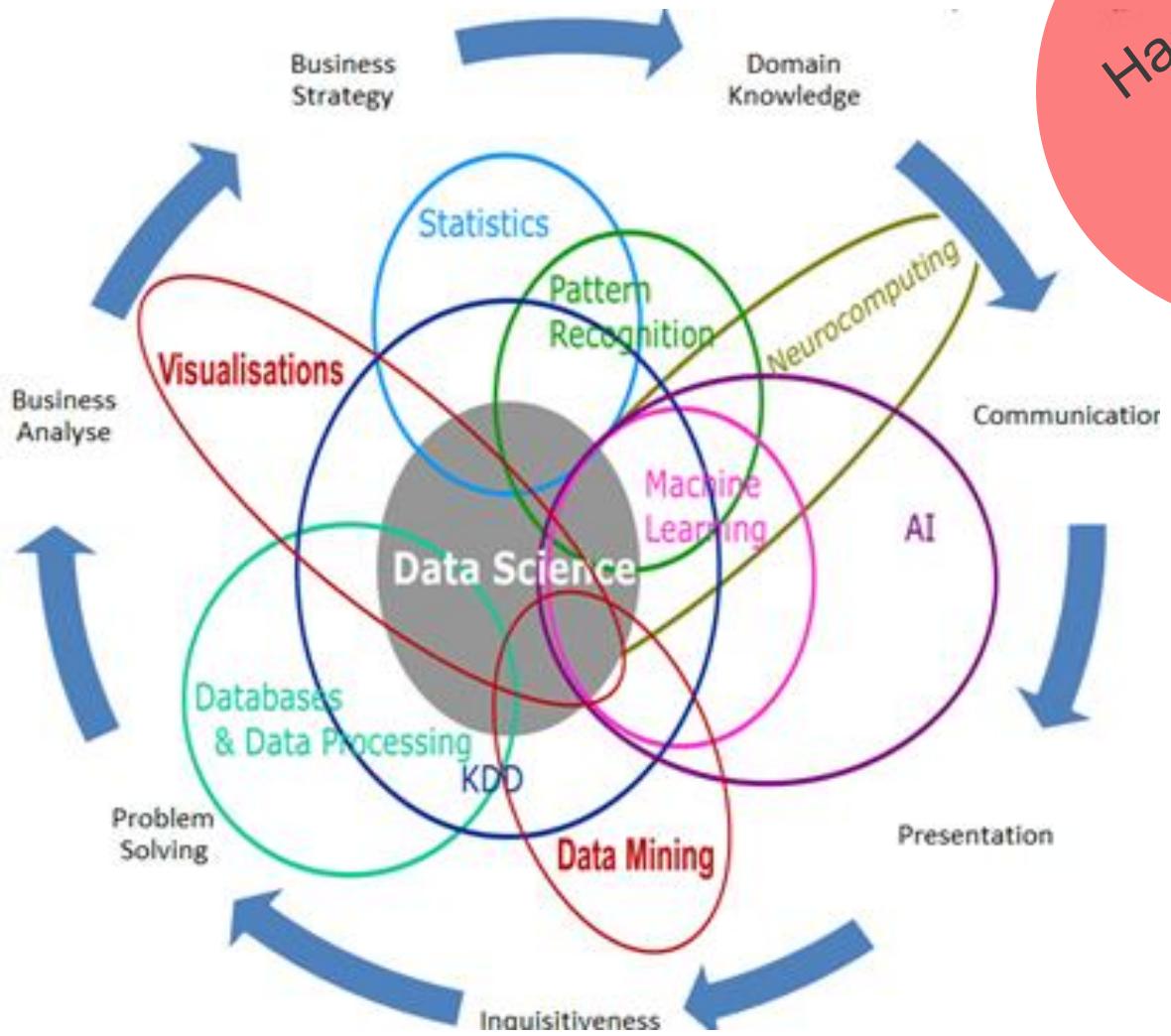


THE MAGAZINE

October 2012

Data Scientist: The Sexiest Job of the 21st Century

Data Science





Analytics

What is analytics?

Analytics is the scientific process of deriving **insights** from **data** in order to make **decisions**



Descriptive Analytics
What has happened?

Predictive Analytics
What will happen?

Prescriptive Analytics and Artificial Intelligence
What should we do?

Business Value

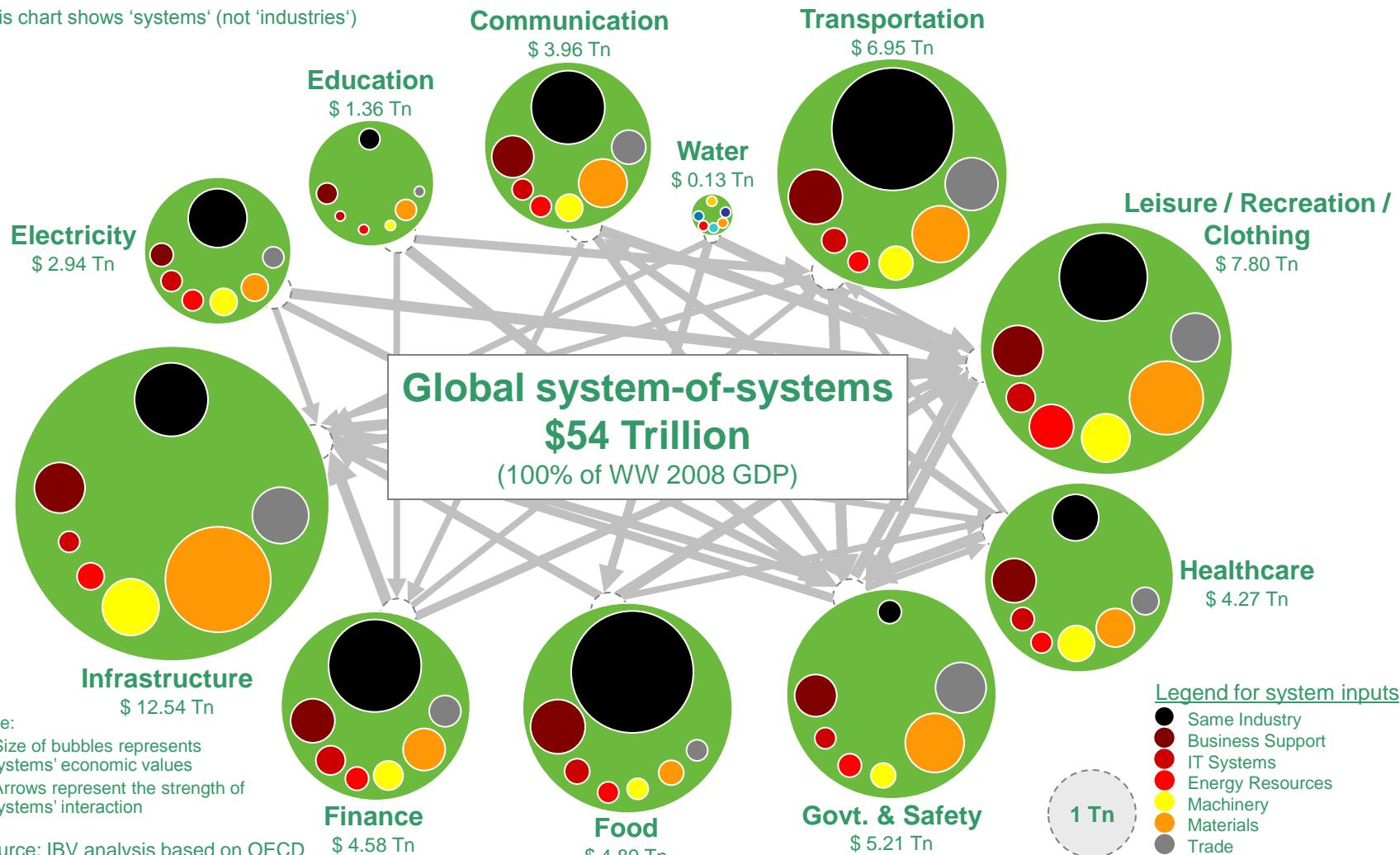
Operations research

- **Operations Research** (O.R.) is the discipline of applying advanced analytical methods to help make better decisions
 - Analytical techniques:
 - Simulation – giving you the ability to try out approaches and test ideas for improvement
 - Optimization – narrowing your choices to the very best when there are virtually innumerable feasible options and comparing them is difficult
 - Probability and Statistics – helping you measure risk, mine data to find valuable connections and insights, test conclusions, and make reliable forecasts
 - Mathematical Modeling – algorithms and software



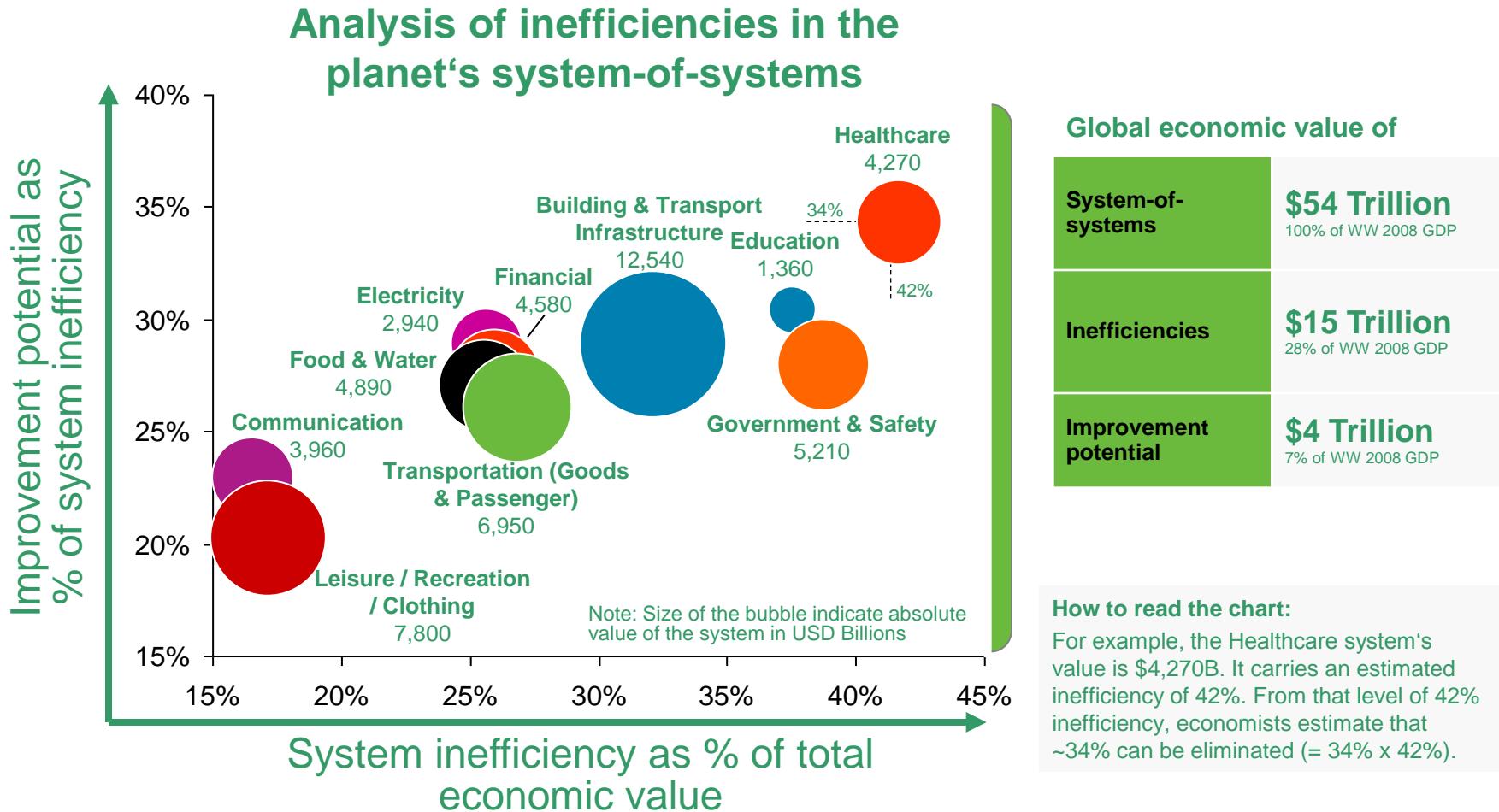
Our planet is a complex, dynamic, highly interconnected \$54 Trillion system-of-systems (OECD-based analysis)

This chart shows 'systems' (not 'industries')



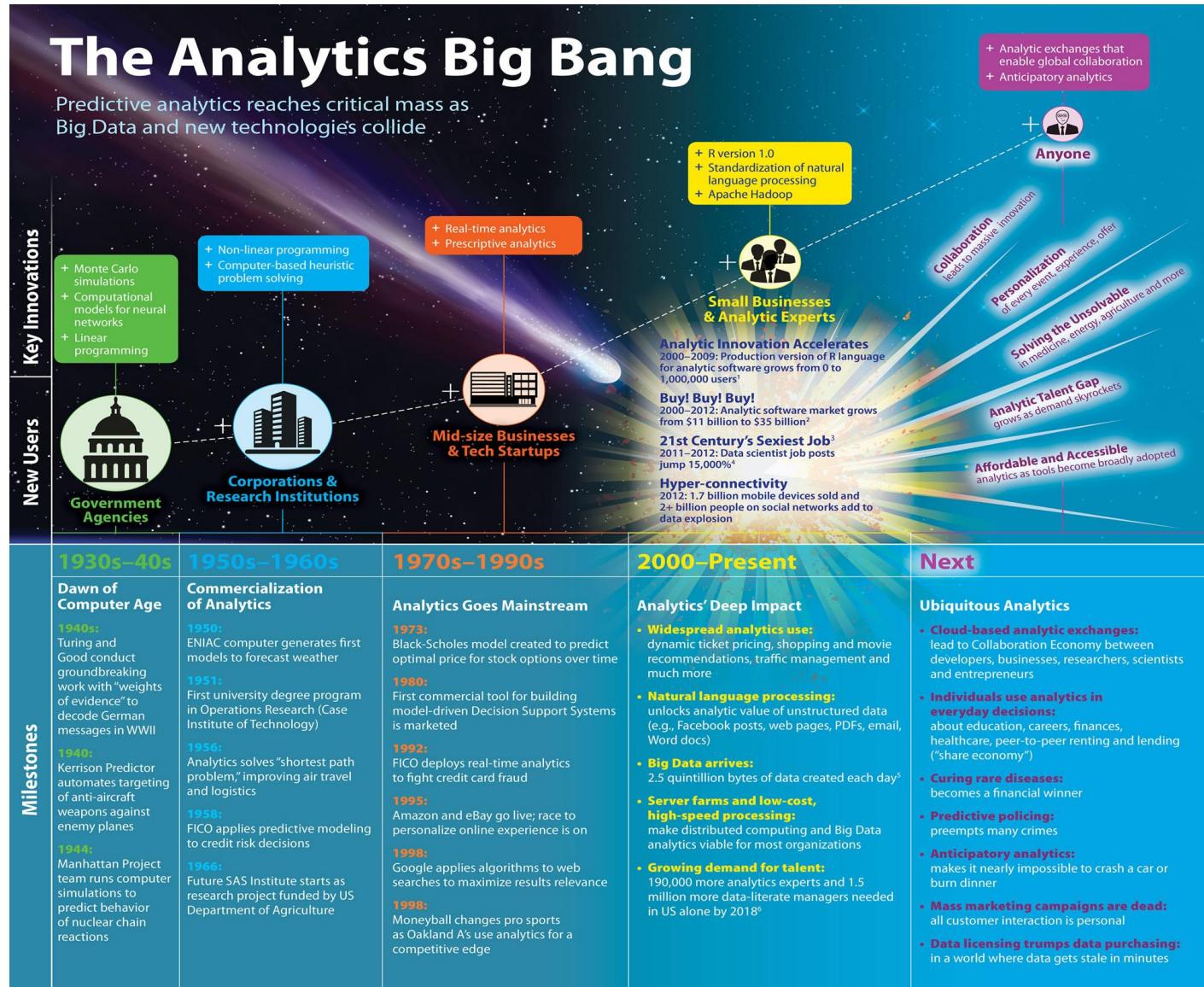
Economists estimate, that all systems carry inefficiencies of up to \$15 Tn, of which \$4 Tn could be eliminated

This chart shows 'systems' (not 'industries')



Source: IBM economists survey 2009; n= 480

History of analytics



History of business analytics

Milestones	Key Innovations	Evolution of Business Analytics		
		New Users	Key Innovations	Impact & Trends
1930s–40s	Government Agencies <ul style="list-style-type: none">+ Monte Carlo simulations+ Computational models for neural networks+ Linear programming Corporations & Research Institutions <ul style="list-style-type: none">+ Non-linear programming+ Computer-based heuristic problem solving	Mid-size Businesses & Tech Startups <ul style="list-style-type: none">+ Real-time analytics+ Prescriptive analytics	Small Businesses & Analytic Experts <ul style="list-style-type: none">+ R version 1.0+ Standardization of natural language processing+ Apache Hadoop	Anyone <ul style="list-style-type: none">+ Analytic exchanges that enable global collaboration+ Anticipatory analytics <p>Collaboration leads to massive innovation</p> <p>Personalization of every event, experience, offer</p> <p>Solving the Unsolvable in medicine, energy, agriculture and more</p> <p>Analytic Innovation Accelerates 2000–2009: Production version of R language for analytic software grows from 0 to 1,000,000 users¹</p> <p>Buy! Buy! Buy! 2000–2012: Analytic software market grows from \$1 billion to \$35 billion²</p> <p>21st Century's Sexiest Job³ 2011–2012: Data scientist job posts jump 15,000%</p> <p>Hyper-connectivity 2012: 1.7 billion mobile devices sold and 2+ billion people on social networks add to data explosion</p> <p>Analytic Talent Gap grows as demand skyrockets</p> <p>Affordable and Accessible analytics as tools become broadly adopted</p>
1950s–1960s	Commercialization of Analytics <ul style="list-style-type: none">1940: Turing and Good conduct groundbreaking work with "weights of evidence" to decode German messages in WWII1940: Kerrison Predictor automates targeting of anti-aircraft weapons against enemy planes1944: Manhattan Project team runs computer simulations to predict behavior of nuclear chain reactions1950: ENIAC computer generates first models to forecast weather1951: First university degree program in Operations Research (Case Institute of Technology)1956: Analytics solves "shortest path problem," improving air travel and logistics1958: FICO applies predictive modeling to credit risk decisions1966: Future SAS Institute starts as research project funded by US Department of Agriculture	Analytics Goes Mainstream <ul style="list-style-type: none">1973: Black-Scholes model created to predict optimal price for stock options over time1980: First commercial tool for building model-driven Decision Support Systems is marketed1992: FICO deploys real-time analytics to fight credit card fraud1995: Amazon and eBay go live; race to personalize online experience is on1998: Google applies algorithms to web searches to maximize results relevance1998: Moneyball changes pro sports as Oakland A's use analytics for a competitive edge	2000–Present <ul style="list-style-type: none">Analytics' Deep Impact<ul style="list-style-type: none">Widespread analytics use: dynamic ticket pricing, shopping and movie recommendations, traffic management and much moreNatural language processing: unlocks analytic value of unstructured data (e.g., Facebook posts, web pages, PDFs, email, Word docs)Big Data arrives: 2.5 quintillion bytes of data created each day⁵Server farms and low-cost, high-speed processing: make distributed computing and Big Data analytics viable for most organizationsGrowing demand for talent: 190,000 more analytics experts and 1.5 million more data-literate managers needed in US alone by 2018⁶	Next <ul style="list-style-type: none">Ubiquitous Analytics<ul style="list-style-type: none">Cloud-based analytic exchanges: lead to Collaboration Economy between developers, businesses, researchers, scientists and entrepreneursIndividuals use analytics in everyday decisions: about education, careers, finances, healthcare, peer-to-peer renting and lending ("share economy")Curing rare diseases: becomes a financial winnerPredictive policing: preempts many crimesAnticipatory analytics: makes it nearly impossible to crash a car or burn dinnerMass marketing campaigns are dead: all customer interaction is personalData licensing trumps data purchasing: in a world where data gets stale in minutes



Course Outline

Course summary

- **Course title:** Introduction to Data Science and Analytics
- **Course summary:** The objective of the course is to learn analytical models and overview quantitative algorithms for solving engineering and business problems. Data science or analytics is the process of deriving insights from data in order to make optimal decisions. It allows hundreds of companies and governments to save lives, increase profits and minimize resource usage. Considerable attention in the course is devoted to applications of computational and modeling algorithms to finance, risk management, marketing, health care, smart city projects, crime prevention, predictive maintenance, web and social media analytics, personal analytics, etc. We will show how various data science and analytics techniques such as basic statistics, regressions, uncertainty modeling, simulation and optimization modeling, data mining and machine learning, text analytics, artificial intelligence and visualizations can be implemented and applied using Python. Python and IBM Watson Analytics are modeling and visualization software used in this course. Practical aspects of computational models and case studies in Interactive Python are emphasized.

Course outline

Introduction to data science and analytics

- Data science concepts
- Application areas of quantitative modeling

Python programming, data science software

- Introduction to Python
- Comparison of Python, R and Matlab usage in data science

Basic statistics

- Random variables, sampling
- Distributions and statistical measures
- Hypothesis testing
- Statistics case studies in Ipython

Overview of linear algebra

- Linear algebra and matrix computations
- Functions, derivatives, convexity

Course outline

Modeling techniques, regression

- Mathematical modeling process
- Linear regression
- Logistic regression
- Regression case studies in IPython

Data visualization and visual analytics

- Visual analytics
- IBM Watson Analytics

Simulation modeling

- Random number generation
- Monte Carlo simulations
- Simulation case studies in Ipython

Optimization

- Overview of optimization algorithms
- Optimization case studies in IPython

Course outline

Data mining and machine learning

- Classification (decision trees)
- Clustering (K-means, Fuzzy C-means, Hierarchical Clustering, DBSCAN)
- Association rules
- Data mining case studies in IPython

Cognitive computing and artificial intelligence

- Text analytics
- Social media analytics
- Neural networks
- Spatio-temporal analytics
- Cognitive computing case studies in IPython

Storytelling based on analytics, analytical decision making

- Validating analytics
- Storytelling based on analytics
- Decision-making based on analytics

Assignments, exams and grading (tentative)

Assignment #1 – Solving an analytics problem in Python (**15%**)

- Individual assignment.

Assignment #2 – Solving an analytics problem in Python (**15%**)

- Individual assignment.

Course Project (Assignment #3 and Assignment #4) – Smart city analytics via machine learning and data analytics in Python (**30%**)

- Group project (groups of 6 students), the same groups as for In-Class Presentations.

In-Class Group Presentation (15%)

- Group presentations of up to 10 minutes are required to cover topics related to additional course materials and the course project.

Final Exam (25%)

- For the final exam you may be responsible for analyzing, computing and writing up a solution to case problems. Each solution must be completed individually.

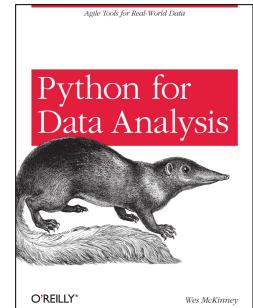
Notes

- If a student gets less than 50% mark at the Final Exam, her/his course mark will be reduced one letter grade down. E.g., a student got 14 pts (Assg 1) + 13 pts (Assg 2) + 28 pts (Course Project) + 14 pts (In-Class Presentation) + 12 pts (Final Exam) = 81 pts that corresponds to A- course mark, but because a student got 12 pts out of 25 pts at the Final Exam (less than 50%), the course mark will be reduced from A- to B+.

Course materials and readings

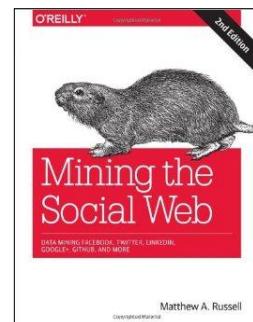
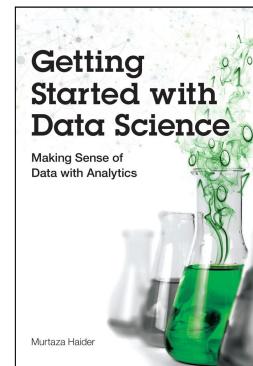
Required

- **Course slides** by O. Romanko and D. Rosu, 2017
[Quercus](#)



Optional

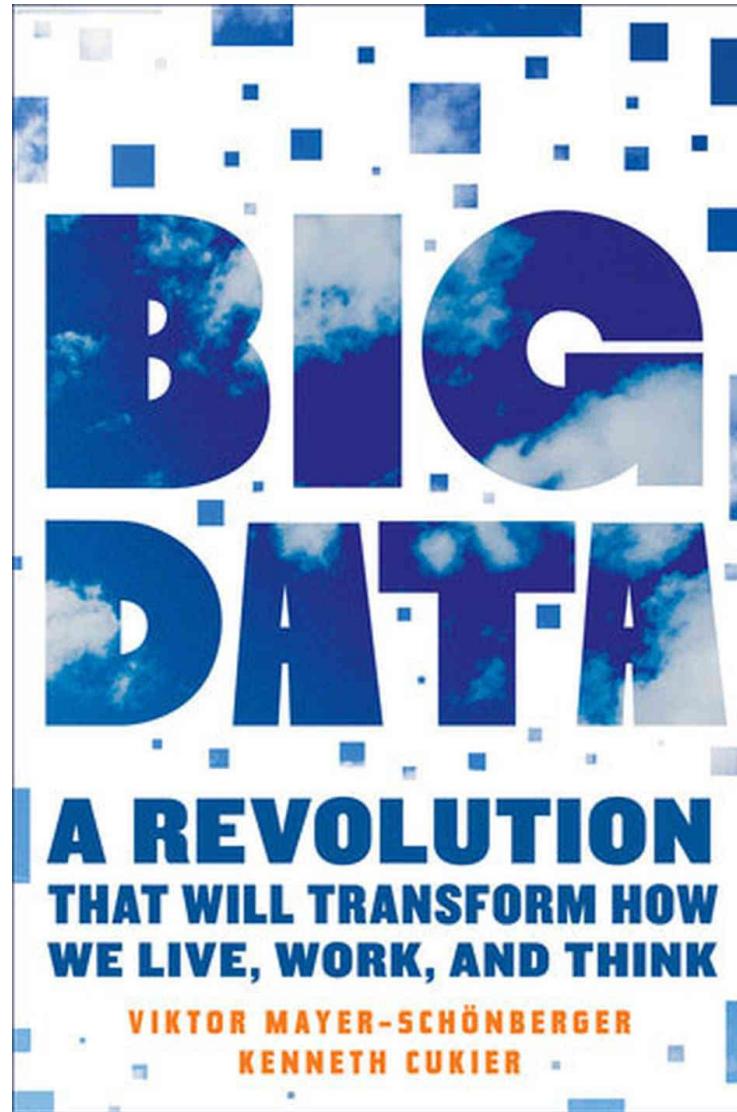
- **Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Ipython** by W. McKinney, 2012
<https://www.amazon.com/Python-Data-Analysis-Wrangling-IPython/dp/1449319793/>
- **Getting Started with Data Science: Making Sense of Data with Analytics** by M. Haider, 2015
<https://www.amazon.com/Getting-Started-Data-Science-Analytics/dp/0133991024/>
- **Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Google+, GitHub, and More** by M. Russell, 2013
<https://www.amazon.com/Mining-Social-Web-Facebook-LinkedIn/dp/1449367615/>



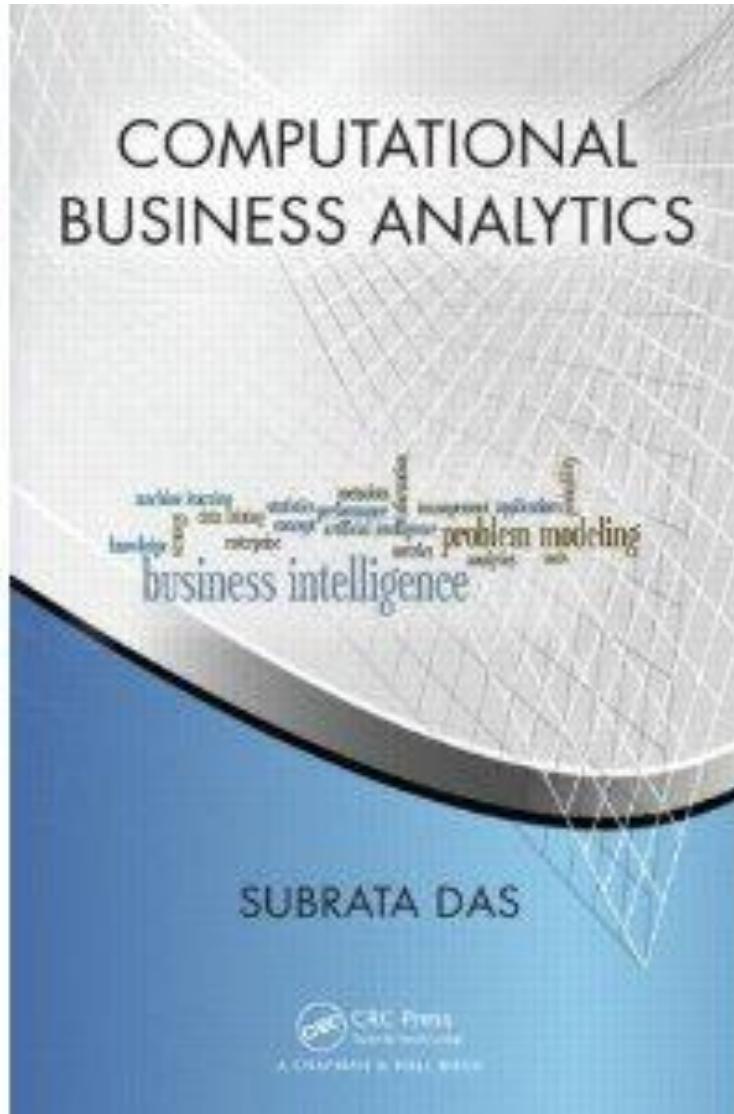
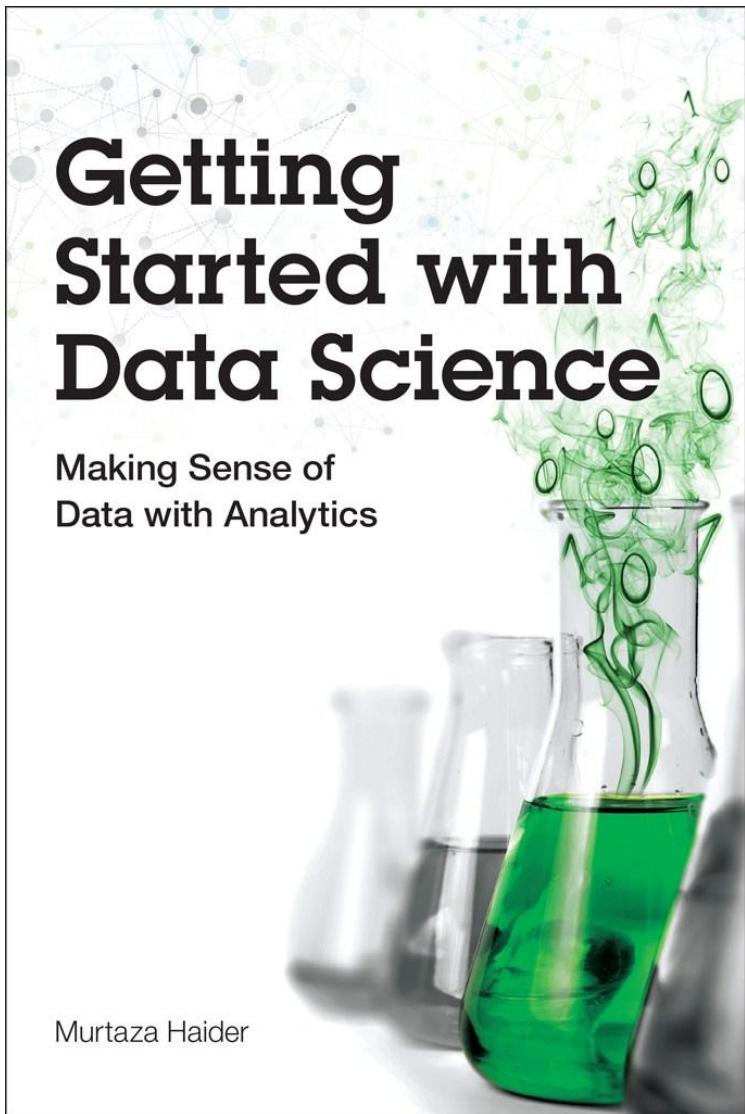


Recommended Literature

Literature



Literature



Literature

Agile Tools for Real-World Data

Python for Data Analysis



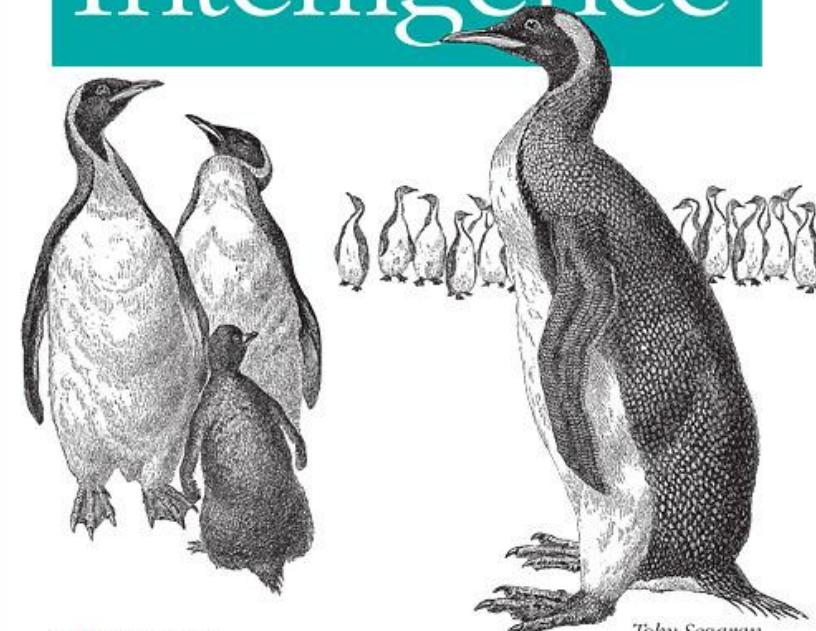
O'REILLY®

Wes McKinney

Building Smart Web 2.0 Applications

Programming

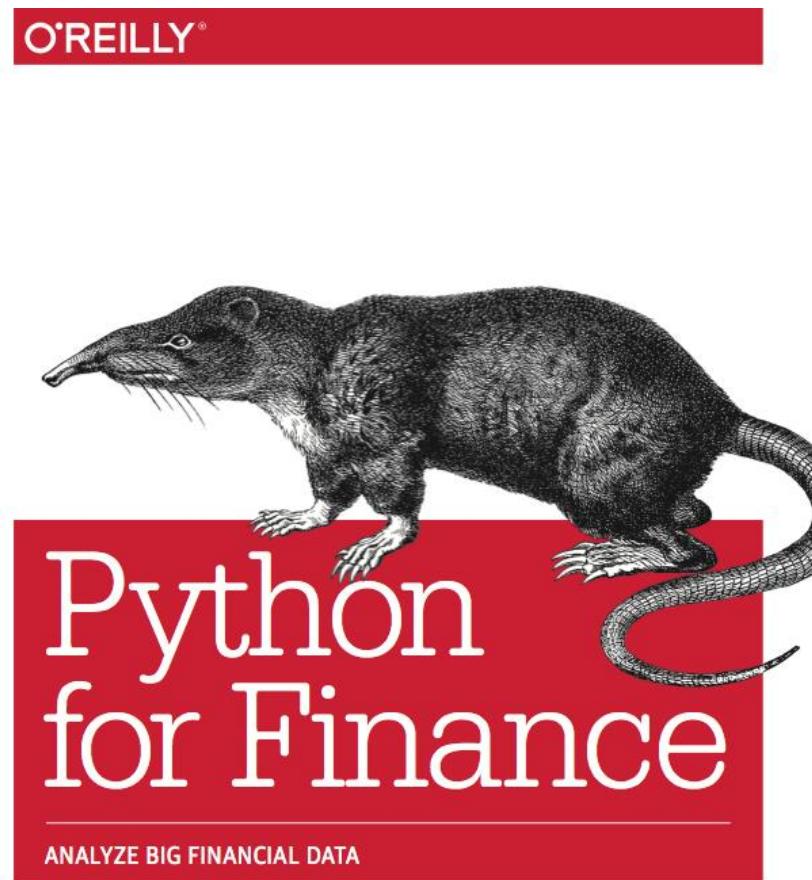
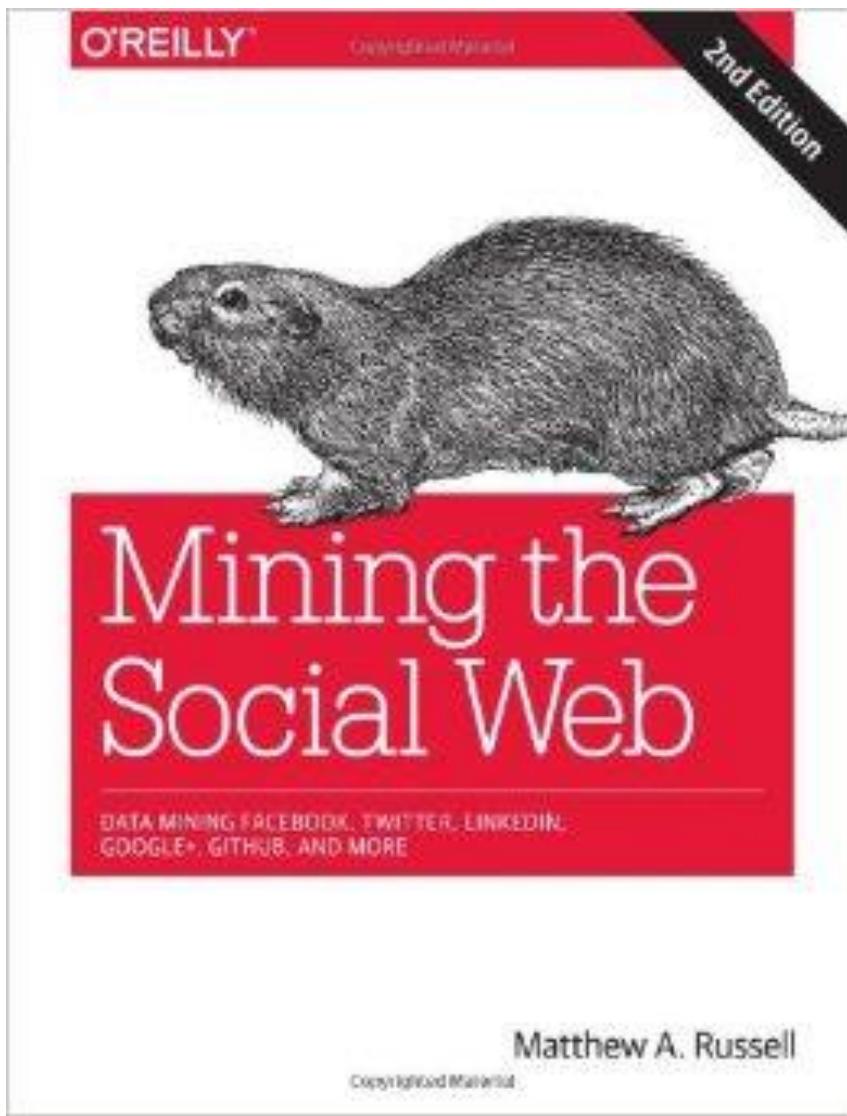
Collective Intelligence



O'REILLY®

*Toby Segaran
Foreword by Tim O'Reilly*

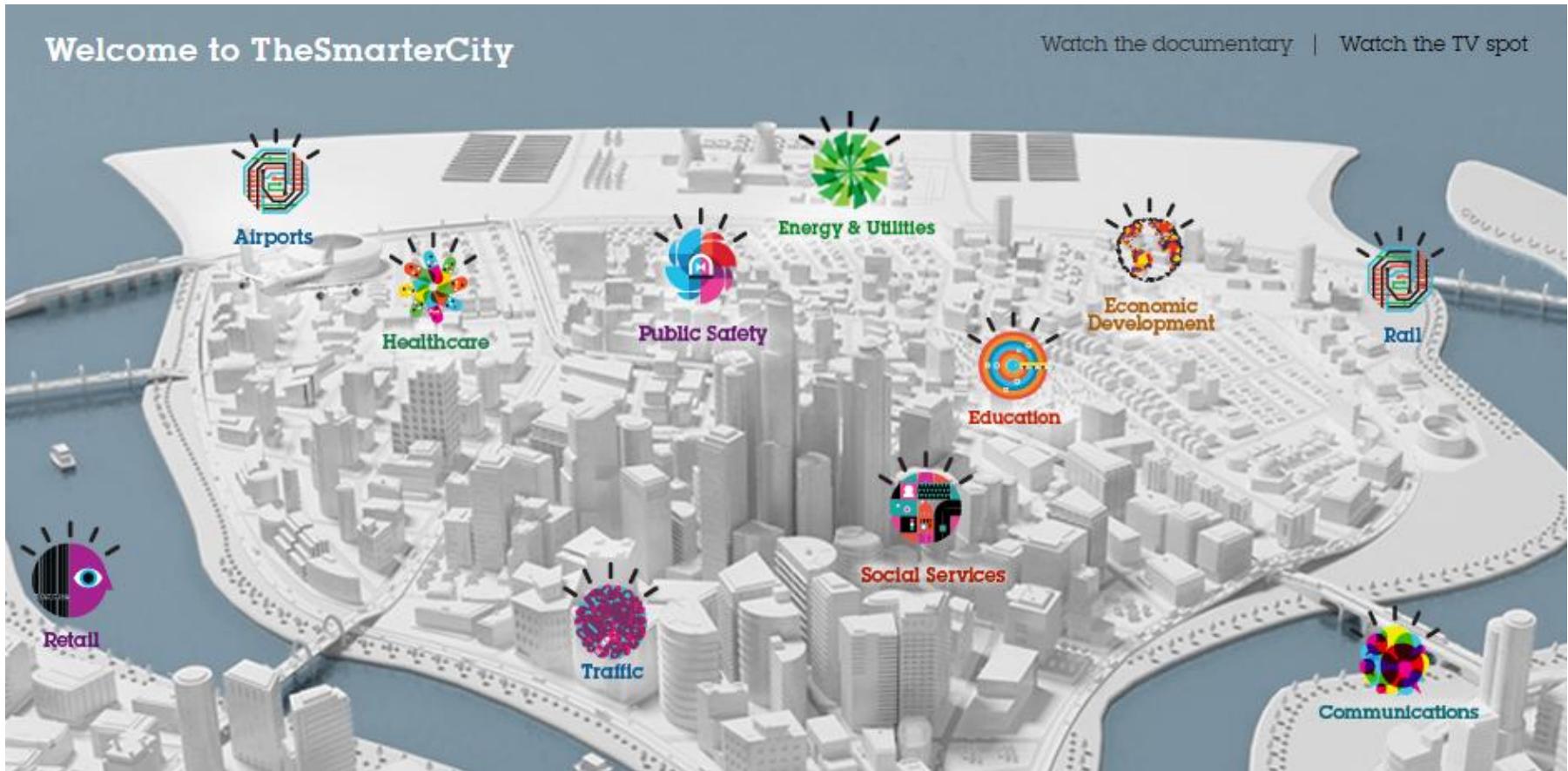
Literature





Analytics Examples

Smarter Cities



Use of camera phones at the Papal inauguration in 2005 and 2013



Data reveals hidden city dynamics



We can collect information from almost everything to make better decisions

30 billion

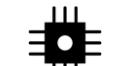
RFID tags
embedded into our
world and across
entire ecosystems

1 billion

Camera phones in
existence able to
document accidents,
damage, and crimes

85%

Of new automobiles
will contain event data
recorders collecting
travel information



Instrumented



Interconnected



Intelligent



What is big data?

Big data are datasets that grow so large that they become awkward to work with using on-hand database management tools.

Difficulties include capture, storage, search, sharing, analytics, and visualizing.

Source: Wikipedia

Big social data



Applications of big data analytics

Smarter Healthcare



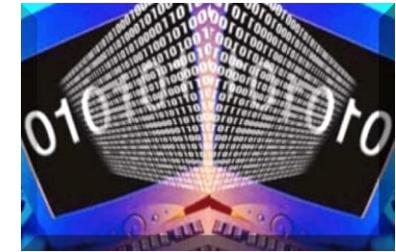
Multi-channel



Finance



Log Analysis



Homeland Security



Traffic Control



Telecom



Search Quality



Manufacturing



Trading Analytics



Fraud and Risk

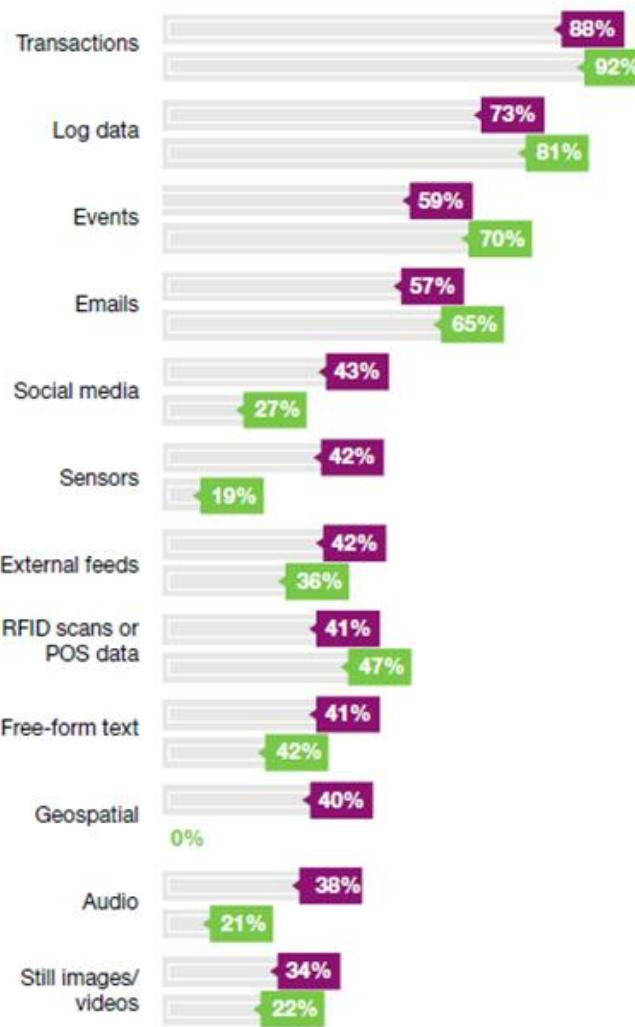


Retail: Churn, NBO

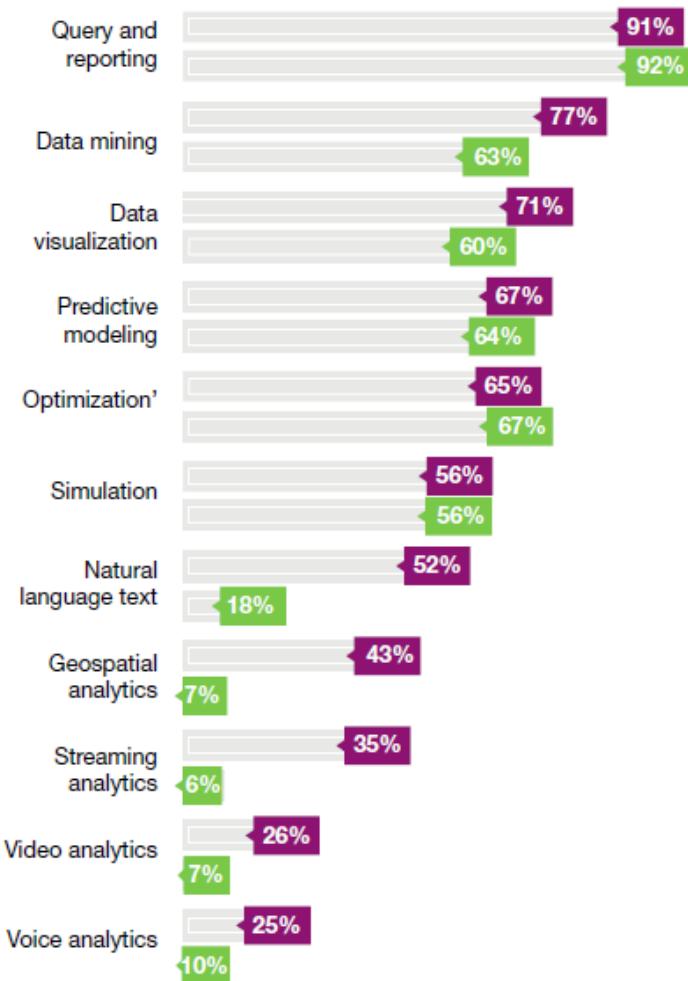


Use of Big Data globally and in the financial sector

Big data sources



Analytics capabilities



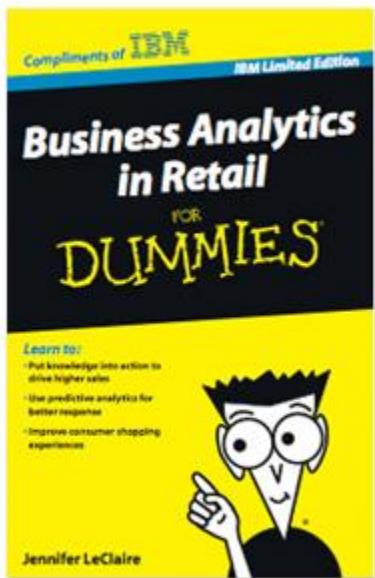
■ Global

■ Banking and Financial Markets

Global

Banking and Financial Markets

Multiple responses accepted



IBM Predictive Analytics in

RETAIL

What will your customers want next?



90%

of shoppers will spend up to 20 minutes setting up preferences for personalized offers¹

55%

of shoppers expect retailers to offer relevant promotions based on past purchases²

43%

want their prior purchases to result in new product recommendations³



Fitting room analytics

Good



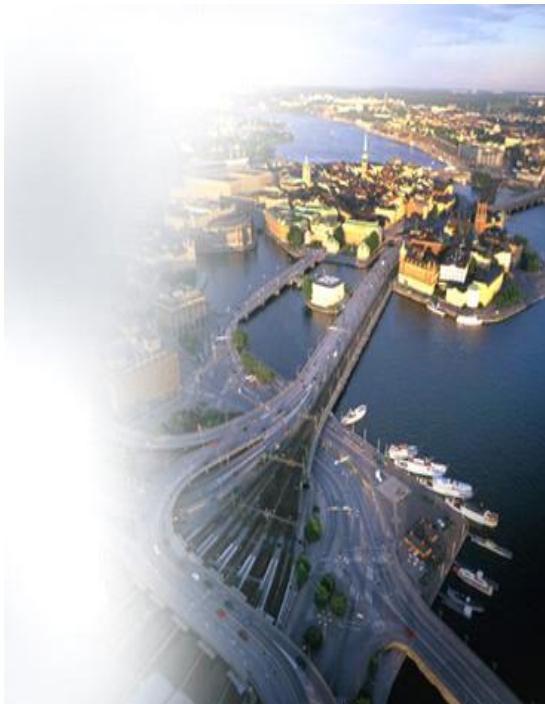
Bad



Source: Adme

Intelligent transport systems

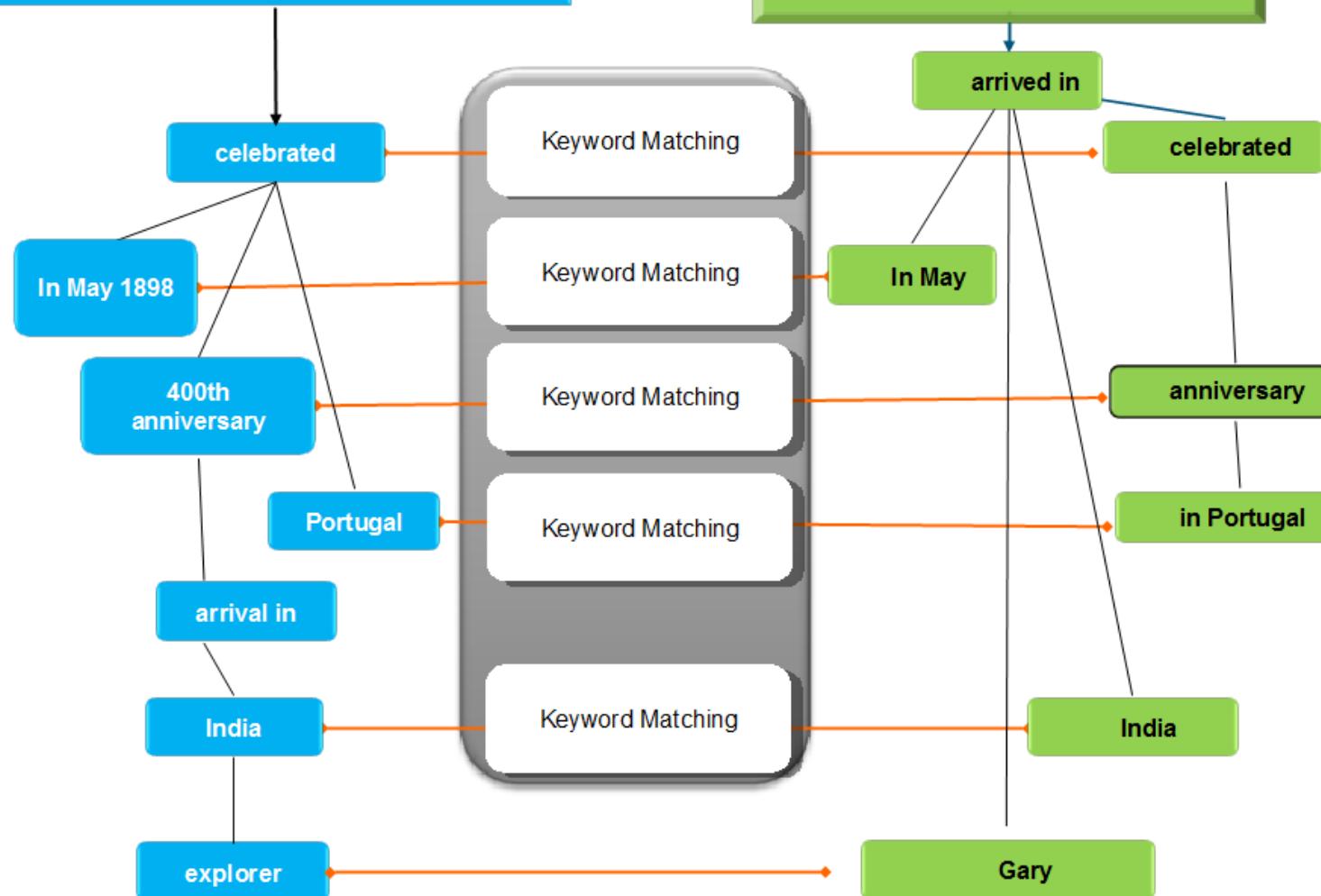
- **Real time monitoring & forecasting of congestion in cities enables real time action to reduce traffic and emissions**
 - Can charge drivers at point of use for access to city centers
- **Stockholm Congestion Tax Project**
 - Involves 18 barrier-free control points
 - Allows differentiated pricing by time of day, congestion level, and potentially emissions level
 - Results:
 - Traffic reduced by 100,000 vehicle passages per day (25%)
 - Public transportation passengers increased by 40,000 / day
 - Congestion during peak hours and CO₂ emissions were dramatically reduced



Artificial intelligence

In May 1898 Portugal celebrated the 400th anniversary of this explorer's arrival in India.

In May, Gary arrived in India after he celebrated his anniversary in Portugal.



Artificial intelligence

In May 1898 Portugal celebrated the 400th anniversary of this explorer's arrival in India.

celebrated

Portugal

May 1898

400th anniversary

arrival in

India

explorer

- Search Far and Wide
- Explore many hypotheses
- Find Judge Evidence
- Many inference algorithms

Temporal Reasoning

Statistical Paraphrasing

GeoSpatial Reasoning

On the 27th of May 1498, Vasco da Gama landed in Kappad Beach

landed in

27th May 1498

Kappad Beach

Vasco da Gama

Date Math

Par-phrases

Geo-KB

IBM Watson Analytics

The screenshot displays the IBM Watson Analytics interface with several key features highlighted:

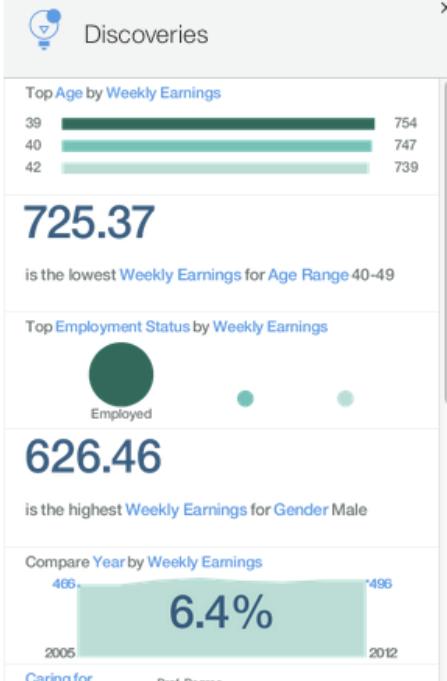
- Data access and refinement**: A blue callout points to the "Analysis Detail" section, which shows "Target : 2 targets.", "Sales Won or Lost", and statistics like "146 Input Fields were evaluated" and "60 Input Fields were potentially useful".
- Integrated social business**: A blue callout points to the top right corner of the interface.
- Intelligent automation**: A blue callout points to the "Predictive Model" section, which illustrates a "Combination Predictive Model" where multiple drivers (1-8) influence a central "Sales" outcome.
- Guided analytic discovery**: A blue callout points to the bottom left, indicating the model's ease of understanding ("Easier to Understand") compared to its predictive power ("More Predictive").
- Report and dashboard creation**: A blue callout points to the right side of the interface, showing a "Drop content here!" area and various visualization cards.
- Visual storytelling**: A blue callout points to the bottom right, highlighting the "What else is interesting about this field?" section, which includes insights like "Customer Satisfaction is strongly associated with Years of Experience".
- Unified analytics experience**: A large blue callout at the bottom center summarizes the overall user experience.

IBM Watson Analytics – <http://www.ibm.com/watson-analytics>

Discovery 1



What is the breakdown of **Weekly Earnings** by **Education Level** ?



Education Level

Weekly Earnings

Heat by

Rows

	Age Range	Education Level	Employment S...	Year	Gender	Age	Television	Housework	Socializing & R...	Weekly Earnings	Caring for Ch...
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IBM Watson Analytics – <http://www.ibm.com/watson-analytics>



IBM Debater

<https://youtu.be/naQujxmg9gg>





Modeling

Questions that we can try to answer with models

- **Statistics** – exploratory analysis and hypothesis testing
 - ✓ Decisions made from samples
 - ✓ Hypothesis testing
- **Machine learning** – learning from examples
 - ✓ Supervised learning (prediction, classification)
 - ✓ Unsupervised learning (clustering, associations)
- **Artificial intelligence** – advanced analytics
 - ✓ Text analytics, social media analytics, NLP
 - ✓ Spatio-temporal analytics
 - ✓ Image and visual recognition
 - ✓ Reinforcement learning and autonomous systems
- **Modeling uncertainty** – what would happen in the future?
 - ✓ Monte Carlo simulations
- **Optimizing decisions** – what's best?
 - ✓ Optimization

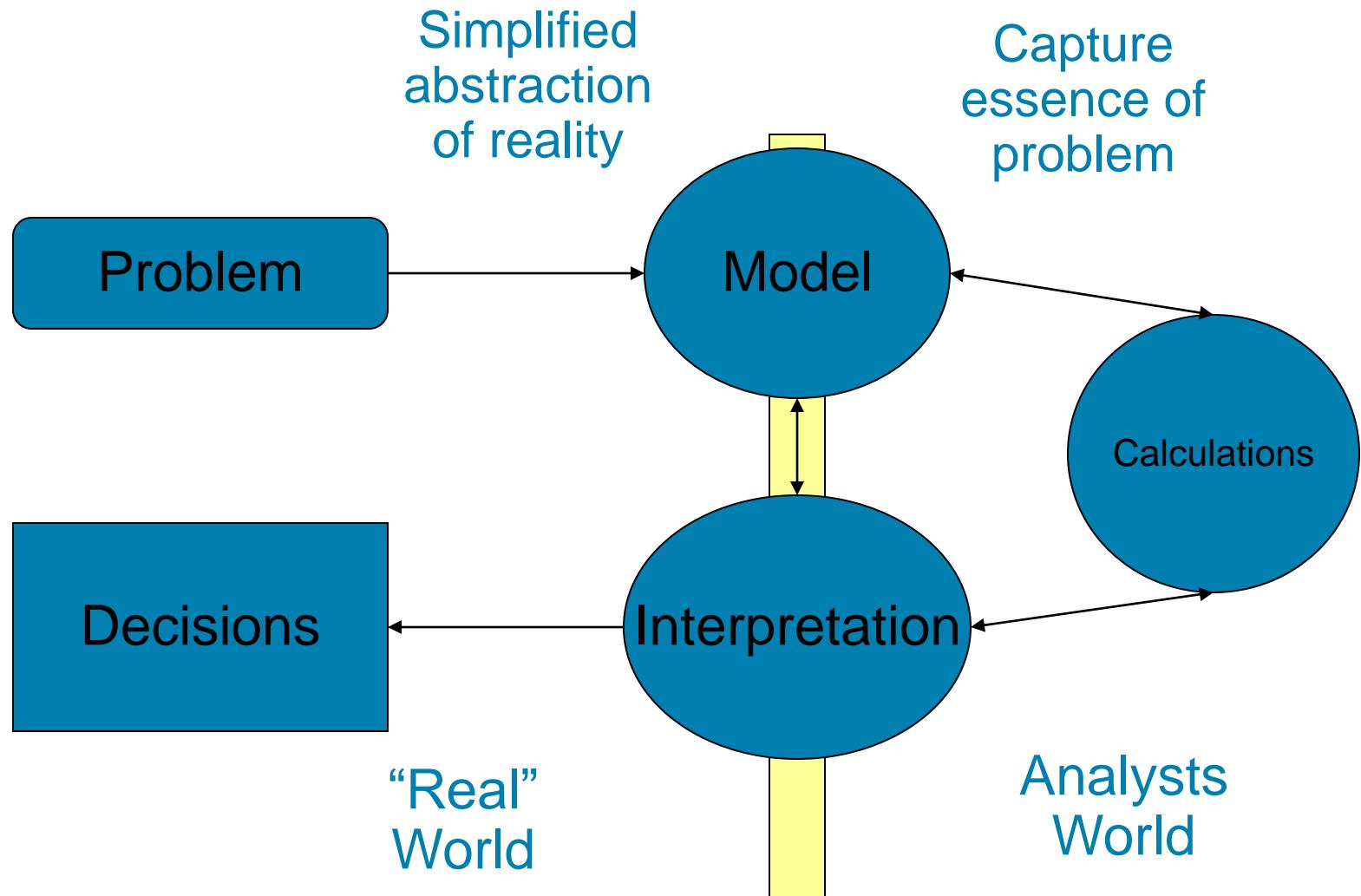
Models



essentially,
all models are wrong,
but some are useful

George E. P. Box

Models and reality





Artificial Intelligence

Text analytics and sentiment analysis

 ShareThis



Sentiment analysis of tweets

Natural Language Processing: ‘bag of words’ and sentiment analysis

examples (news articles)

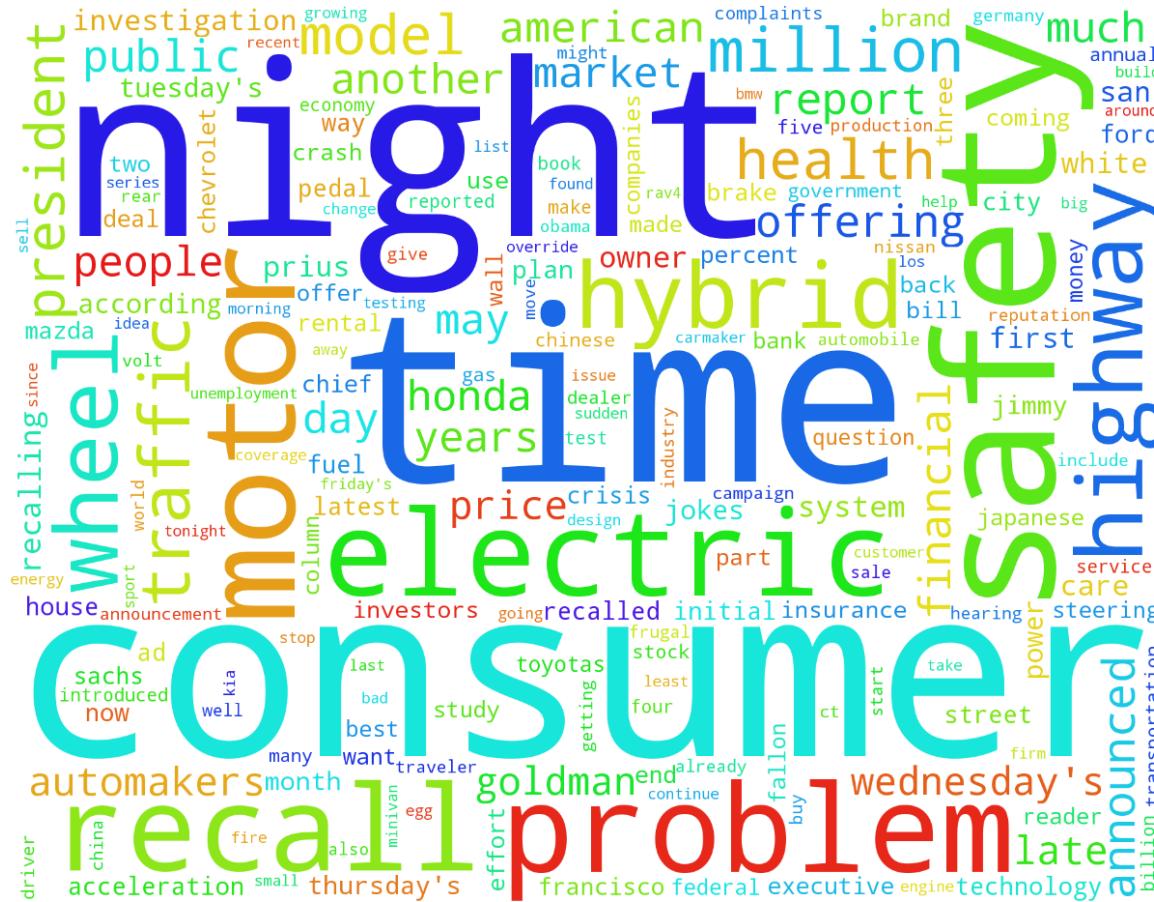
	features (words)					target
	bear	tea	love	bad	drink	sentim
All bears are lovely	1	0	1	0	0	56%
Our tea was bad	0	1	0	1	0	-35%
That bear drinks with bear	2	0	0	0	1	-5%
The bear drinks tea	1	1	0	0	1	4%
We love bears	1	0	1	0	0	63%

Supervised machine learning algorithm:

- Linear regression $\Leftrightarrow y = \beta_0 + \beta_1 \cdot x_1 + \beta_2 \cdot x_2 + \dots + \beta_5 \cdot x_5 + \epsilon$
- Decision trees
- SVM regression
- k-NN regression
- Ensembles (random forests, XGBoost)
- Artificial neural nets (deep learning)

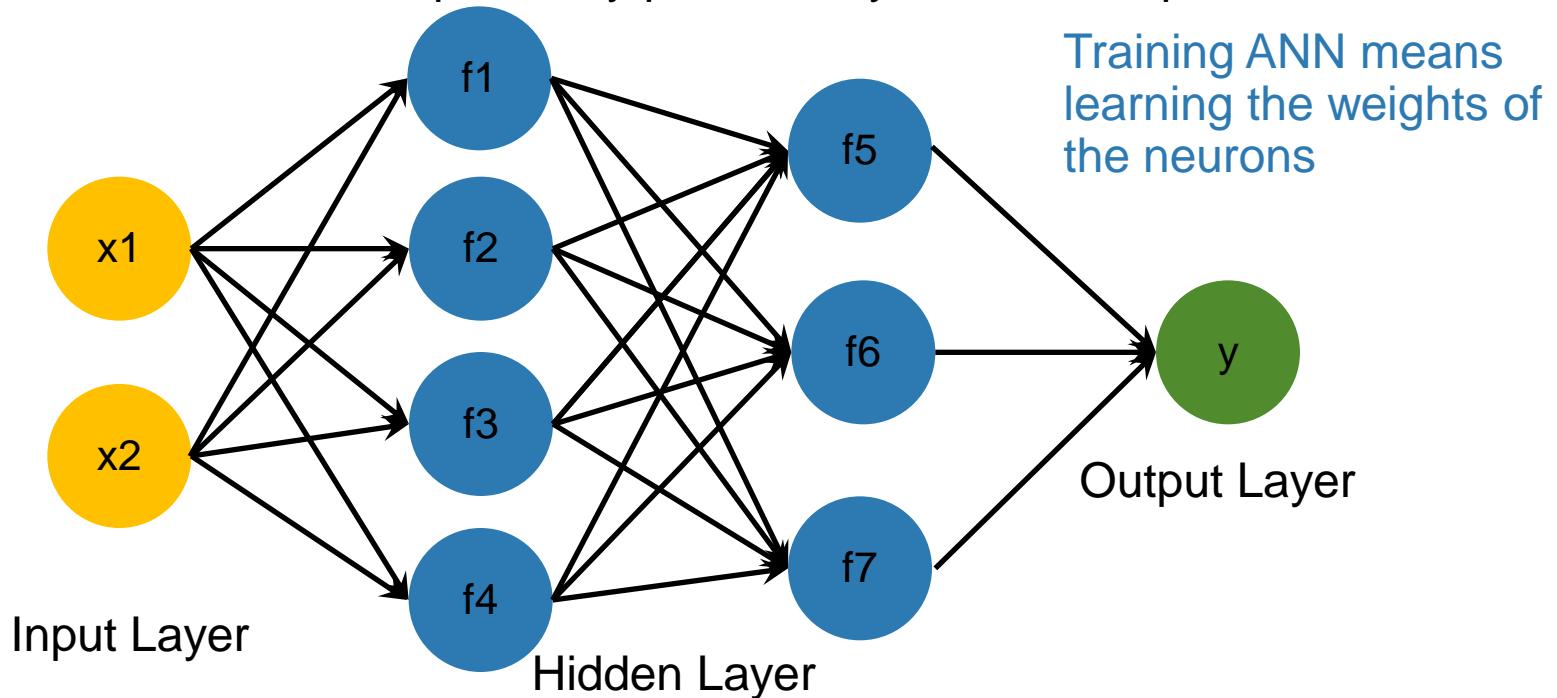
Natural Language Processing: word frequency (Word Cloud)

Word Cloud about Toyota

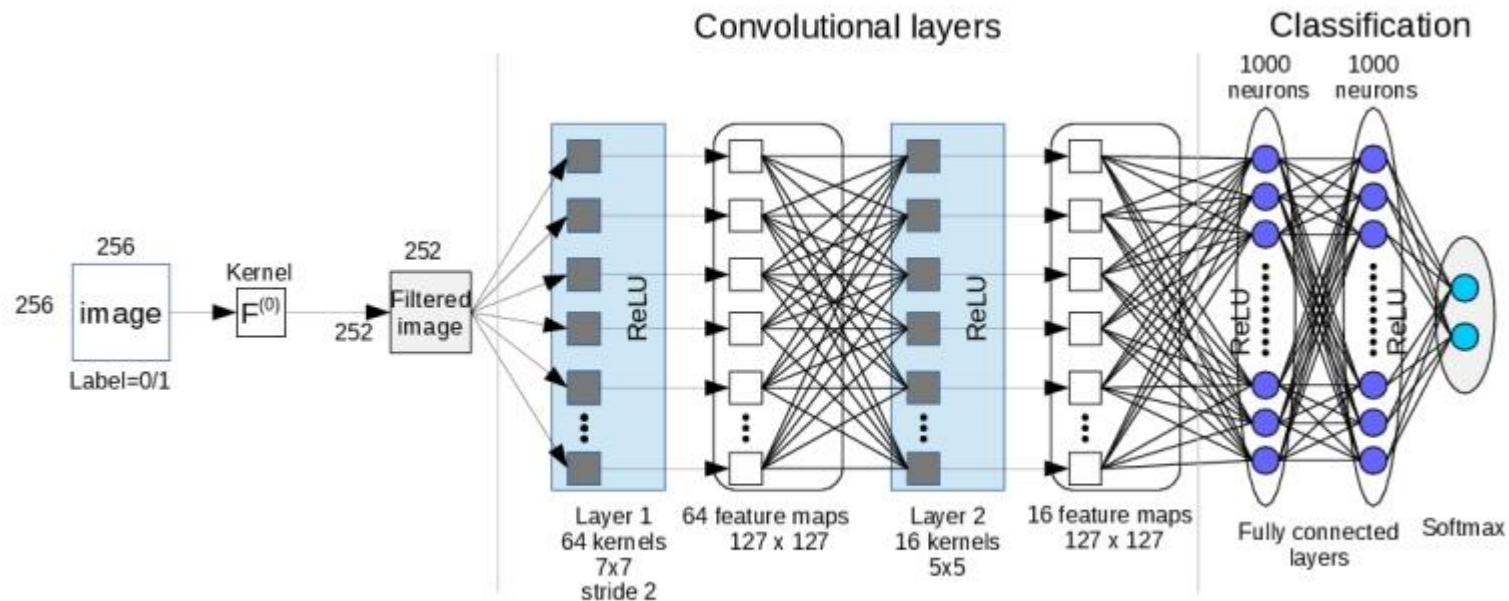
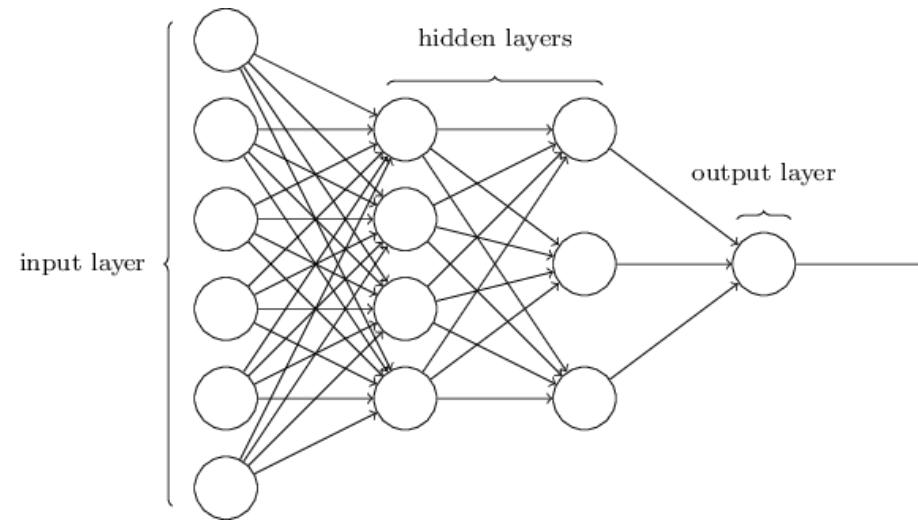


Neural networks and deep learning

- Based loosely on computer models of how brains work
- Model is an assembly of inter-connected neurons (nodes) and weighted links
- Each neuron applies a nonlinear function to its inputs to produce an output
- Output node sums up each of its input value according to the weights of its links
- Used for classification, pattern recognition, speech recognition
- “Black Box” model – no explanatory power, very hard to interpret the results

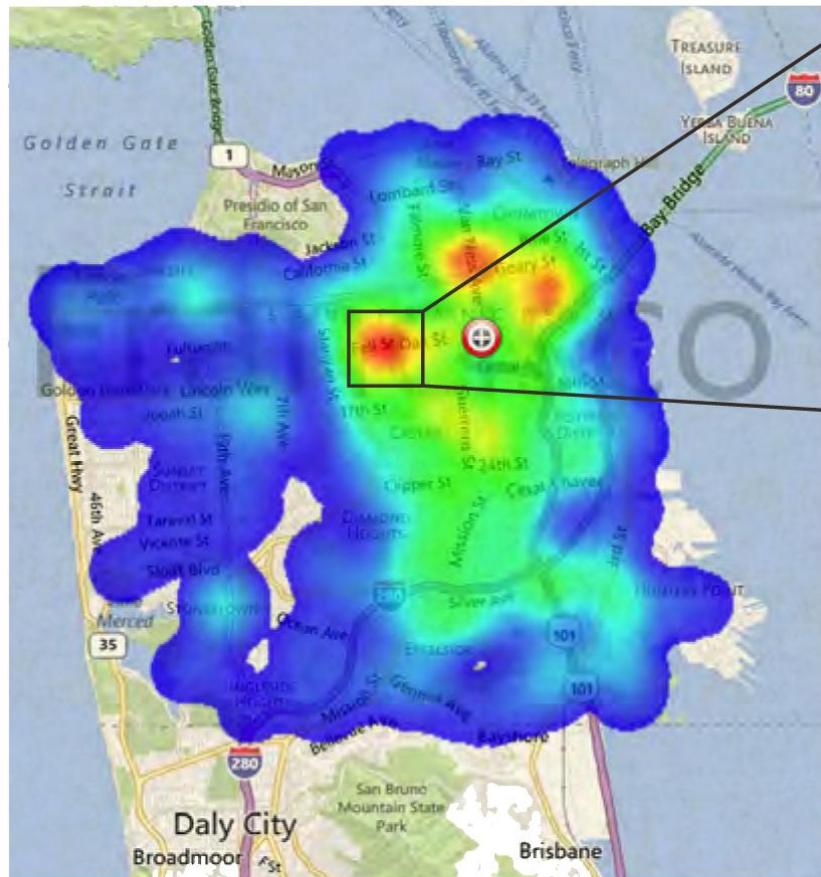


Neural networks and deep learning

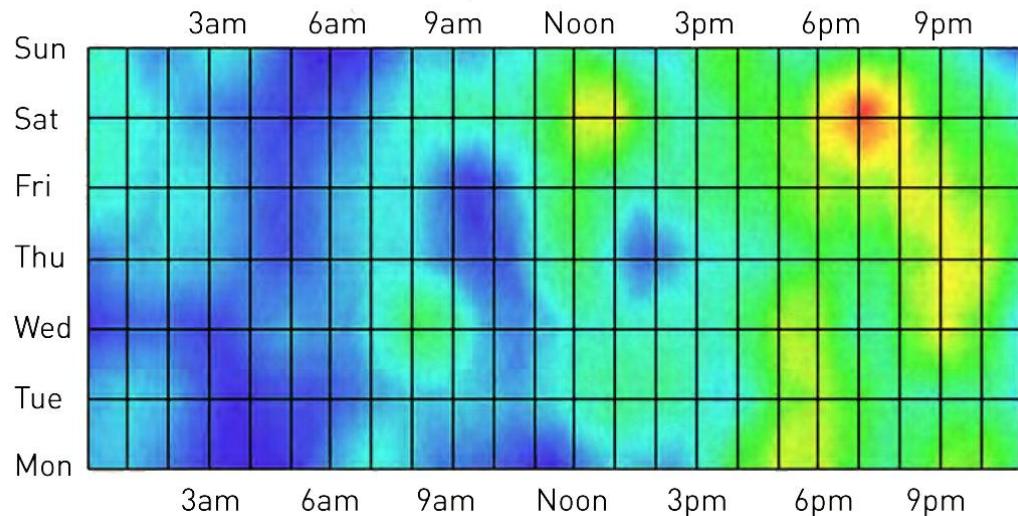


Spatio-temporal analytics – car theft hotspots

GEOSPATIAL HOTSPOTS



TEMPORAL HOTSPOT





Cloud

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Platform Boilerplates APIs Application Services Blockchain Cloud Foundry Apps Data & Analytics DevOps Finance Functions Integrate Internet of Things Mobile Network Security Watson	Cloudant NoSQL DB Cloudant NoSQL DB is a fully managed data layer designed for 	Compose Enterprise IBM Compose Enterprise is a service which provides a private 	Compose for Elasticsearch Elasticsearch combines the power of a full text search engine with the index
	Compose for etcd etcd is a key/value store developers can use to hold the always-correct c 	Compose for JanusGraph JanusGraph is a scalable graph database optimized for storing an 	Compose for MongoDB MongoDB with its powerful indexing and querying, aggregation and wide
	Compose for MySQL MySQL is probably the most popular open source relational database in t 	Compose for PostgreSQL Postgres is a powerful, open source object-relational database that is h 	Compose for RabbitMQ RabbitMQ asynchronously handles the messages between your application
	Compose for Redis Redis is an open-source, blazingly fast, key/value low maintenance store. 	Compose for RethinkDB RethinkDB is a JSON document based, distributed database with an integrat 	Compose for ScyllaDB ScyllaDB is a highly performant, in-place replacement for the Cassand

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- Cloud Foundry Apps
- Data & Analytics
- DevOps
- Finance
- Functions
- Integrate
- Internet of Things
- Mobile
- Network
- Security
- Watson

Watson

 Conversation Add a natural language interface to your application to automate	 Discovery Add a cognitive search and content analytics engine to applications.	 Document Conversion Converts a HTML, PDF, or Microsoft Word™ document into a normalized
 Language Translator Translate text from one language to another for specific domains.	 Natural Language Classifier Natural Language Classifier performs natural language	 Natural Language Understanding Analyze text to extract meta-data from content such as concepts,
 Personality Insights The Watson Personality Insights derives insights from transactions	 Retrieve and Rank Add machine learning enhanced search capabilities to your	 Speech to Text Low-latency, streaming transcription
 Text to Speech Synthesizes natural-sounding speech from text.	 Tone Analyzer Tone Analyzer uses linguistic analysis to detect three types of	 Visual Recognition Find meaning in visual content! Analyze images for scenes, object

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Visual Recognition

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IBM

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AUTHOR IBM
PUBLISHED 09/18/2017
TYPE Service
LOCATION US South, Sydney, United Kingdom

Service name: Visual Recognition-yh

Credential name: Credentials-1

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- Visual Training**
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Sensor



Transmitter



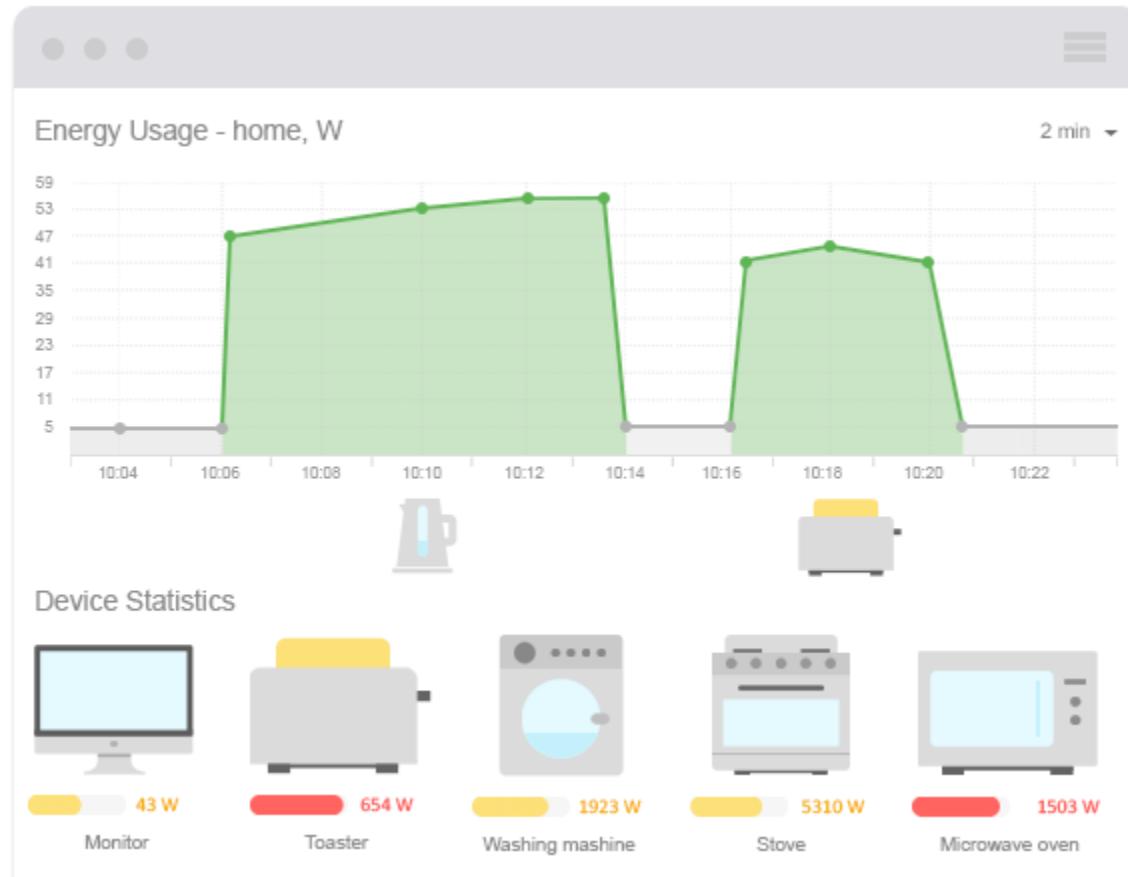
Receiver

HARDWARE



Cloud-based solution

SOFTWARE



Total consumption for the month:

The best - 100 kWh
You - 140 kWh
Average - 170 kWh

Philips HD4656 Kettle 2984 W

In The Kitchen Roland Edvarlum

Buy a teapot. If you are making tea for more than one person you can save on teabags and water. Use a tea cosy or use a woolly hat instead to keep the tea warm. Buy a teapot. If you are making tea for more than one

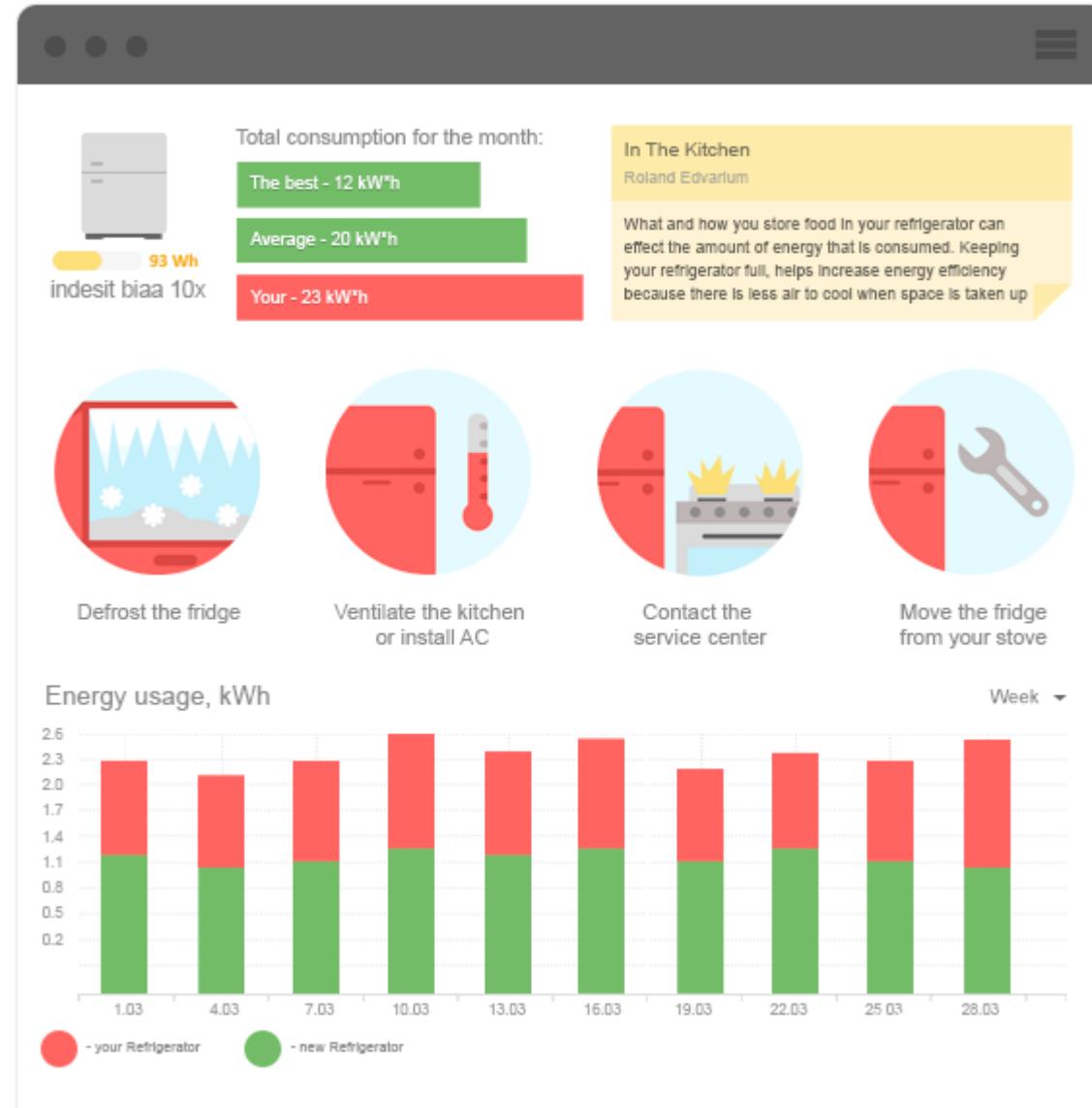
Energy usage, kW

Week ▾

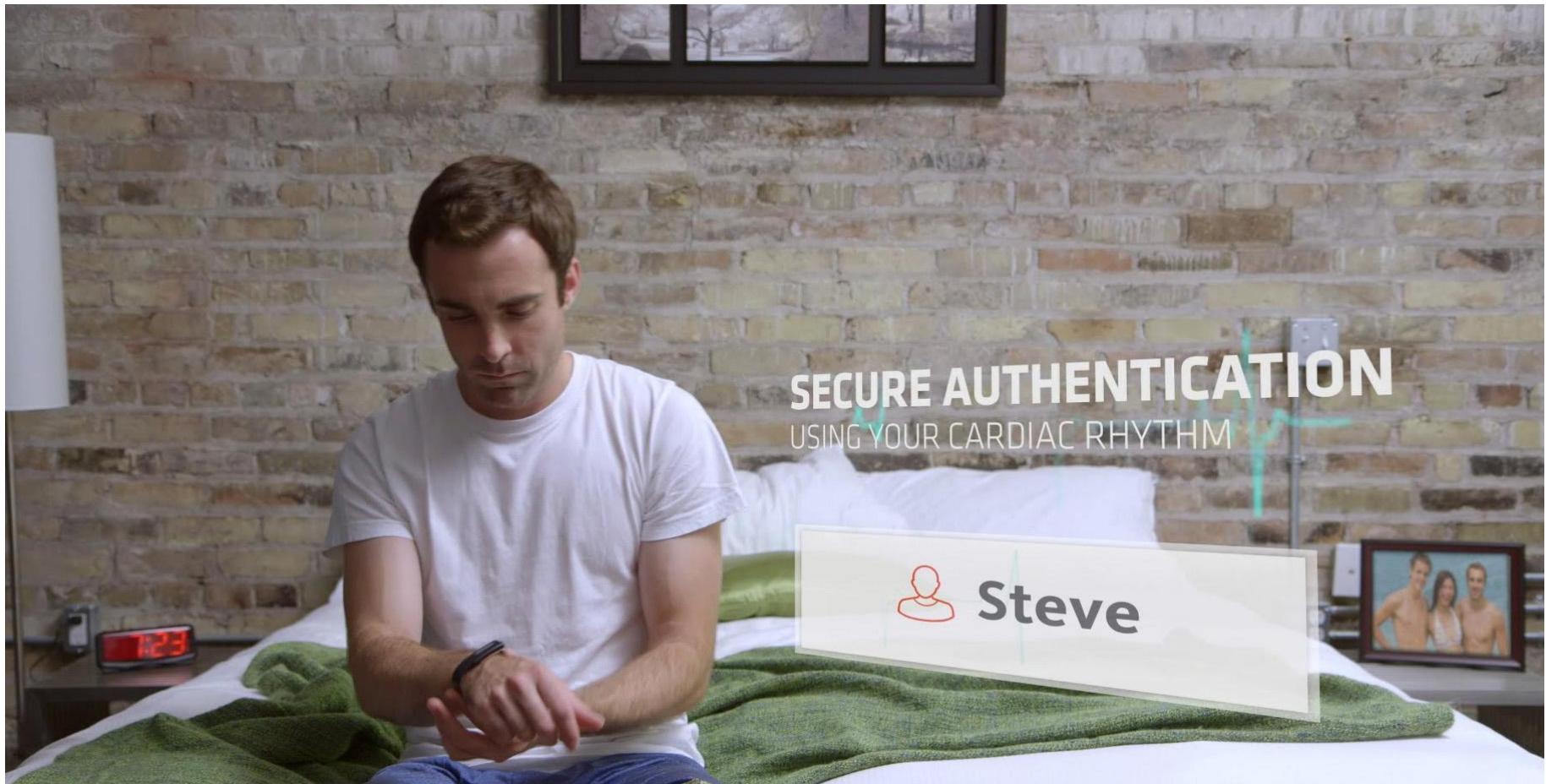
Date	new Kettle (kW)	your Kettle (kW)	Total (kW)
1.03	~2.8	~3.5	~6.3
4.03	~1.8	~2.7	~4.5
7.03	~1.8	~2.7	~4.5
10.03	~3.0	~4.2	~7.2
13.03	~3.0	~4.2	~7.2
16.03	~3.0	~3.8	~6.8
19.03	~3.0	~3.8	~6.8
22.03	~3.5	~4.2	~7.7
25.03	~2.2	~2.2	~4.4
28.03	~3.5	~4.2	~7.7

- your Kettle - new Kettle

Kettle BRAUN WK 500 White save 50 EUR/year [Buy it now for 60 EUR](#)



Nymi





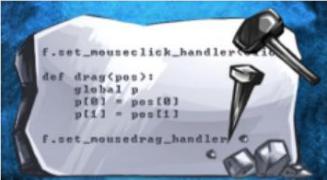
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What you'll learn

- An applied understanding of many different analytics methods, including linear regression, logistic regression, CART, clustering, and data visualization
- How to implement all of these methods in R
- An applied understanding of mathematical optimization and how to solve optimization models in spreadsheet software

	Length:	12 weeks
	Effort:	10 - 15 hours/week
	Price:	FREE Verified Certificate option closed
	Institution:	MITx
	Subject:	Data Analysis & Statistics
	Level:	Intermediate
	Languages:	English
	Video Transcripts:	English

CognitiveClass MOOC

<http://CognitiveClass.ai>

The screenshot shows the homepage of CognitiveClass.ai. At the top, there's a navigation bar with links for Learning Paths, Courses, Badges, Business, Competitions, a search bar, and user options like Login and Sign Up. The main header features a close-up image of a person's eye and the text "Data Science and Cognitive Computing Courses". Below this, a call-to-action button says "Free Courses Sign Up". The next section, titled "What are the benefits?", lists three items: "IT'S FREE" (with a price tag icon), "EARN BADGES" (with a sunburst icon), and "EXPAND YOUR KNOWLEDGE" (with a computer monitor icon). The bottom section, "Follow learning paths to maximize your potential", includes four numbered steps: 1) Select a Learning Path (with a QR code icon), 2) Complete Courses (with a target icon), 3) Earn Badges (with a sunburst icon), and 4) Show off your Badges (with a globe icon).

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Follow learning paths to maximize your potential

- 1) Select a Learning Path
- 2) Complete Courses
- 3) Earn Badges
- 4) Show off your Badges

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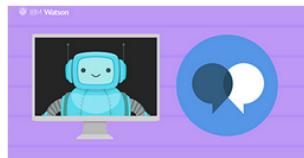
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Intermediate



**Deep Learning with
TensorFlow**

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Advanced



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Watson Analytics 101

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Spark Fundamentals I

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To Do before Lecture 2

Run IPython example provided in class

■ Use Python on cloud via Data Scientist Workbench

- Register for CognitiveClass.ai MOOC portal <https://cognitiveclass.ai> to access 60+ free data science courses and to use Python on the DSW cloud
- You can use Python on DSW cloud via <https://datascientistworkbench.com>

■ Install Python

- Recommended to use Python version 3.X
- You may use your own Python distribution, e.g., Anaconda that can be downloaded from <https://www.anaconda.com/download/>

■ Get access to IBM Cloud

- Register at UofT software portal <http://uoft.onthehub.com> and register for access to IBM Cloud from IBM – Cloud – Cloud Access – IBM Cloud section

■ Check class web-page on Quercus