

Adaptive Business Intelligence: An Introduction with Application Examples

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**DATA SCIENCE
PORTUGAL**



About me: <http://www3.dsi.uminho.pt/pcortez>

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Associate Professor
(Habilitation, PhD)



Contacts:



Paulo Cortez

Paulo Cortez is Associate Professor (with Habilitation) at the Department of Information Systems and Coordinator of the Information Systems and Technologies (IST) research group of ALGORITMI Research Centre, University of Minho (Short CV).

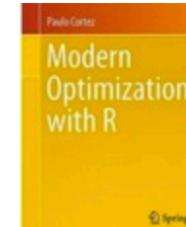
Current research interests:

- * Business Intelligence: Decision Support Systems, Data Mining and Forecasting;
- * Artificial Intelligence (AI): Neural Networks, Evolutionary Computation and AI Applications.

Co-author of more than 110 indexed (e.g., ISI, Scopus) publications in international scientific journals and conferences.

New:

- * Organizer of the Knowledge Discovery and Business Intelligence (KDBI) workshop of EPIA 2017.
 - * Best Paper Award of the EPIA 2015 conference, 2015.
 - * Author of the rminer R package (version 1.4.2, 9/2016).
 - * Springer book: Modern Optimization with R, 2014 (188 pages)
 - * Associate Editor of Expert Systems journal.
 - * New journal article: Using Sensitivity Analysis and Visualization Techniques to Open Black Box Data Mining Models
 - * Video interviews (in Portuguese) about Spam Email: RTP2, Porto Canal, UMinho.
 - * Portuguese book on Intelligent Data Analysis with Java (FCA).
- Are you interested in working with me (PhD, MSc, ...)?



Tweets by @PauloCortez4



Adaptive Business Intelligence: Introduction

The Rise of Artificial Intelligence (AI)

<https://ai100.stanford.edu>

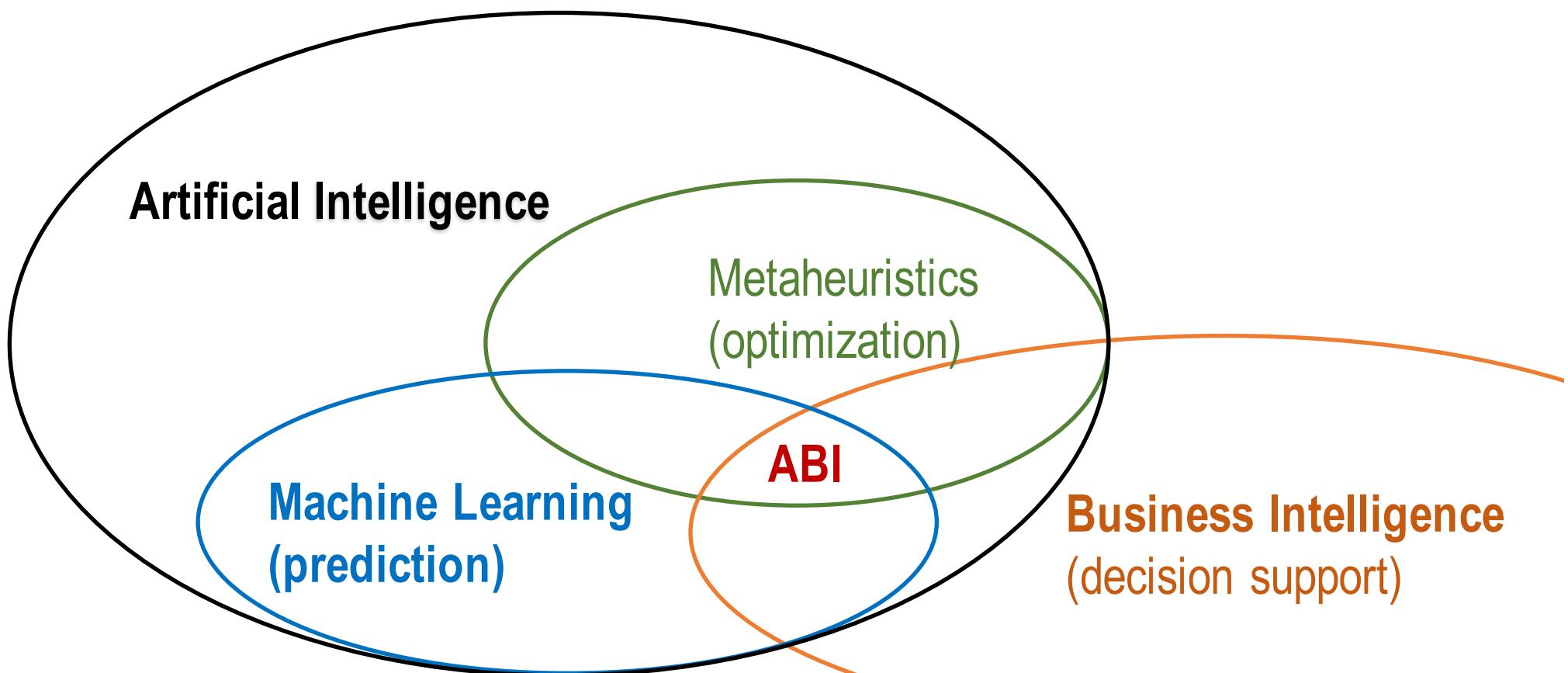
AI has achieved many remarkable milestones, including:

- 1997: IBM's Deep Blue beats Garry Kasparov in Chess.
- 2011: IBM's Watson beats two best human players on Jeopardy.
- 2016: Google's AlphaGo wins Korea's Lee Sedol Go player.



Artificial Intelligence (AI)

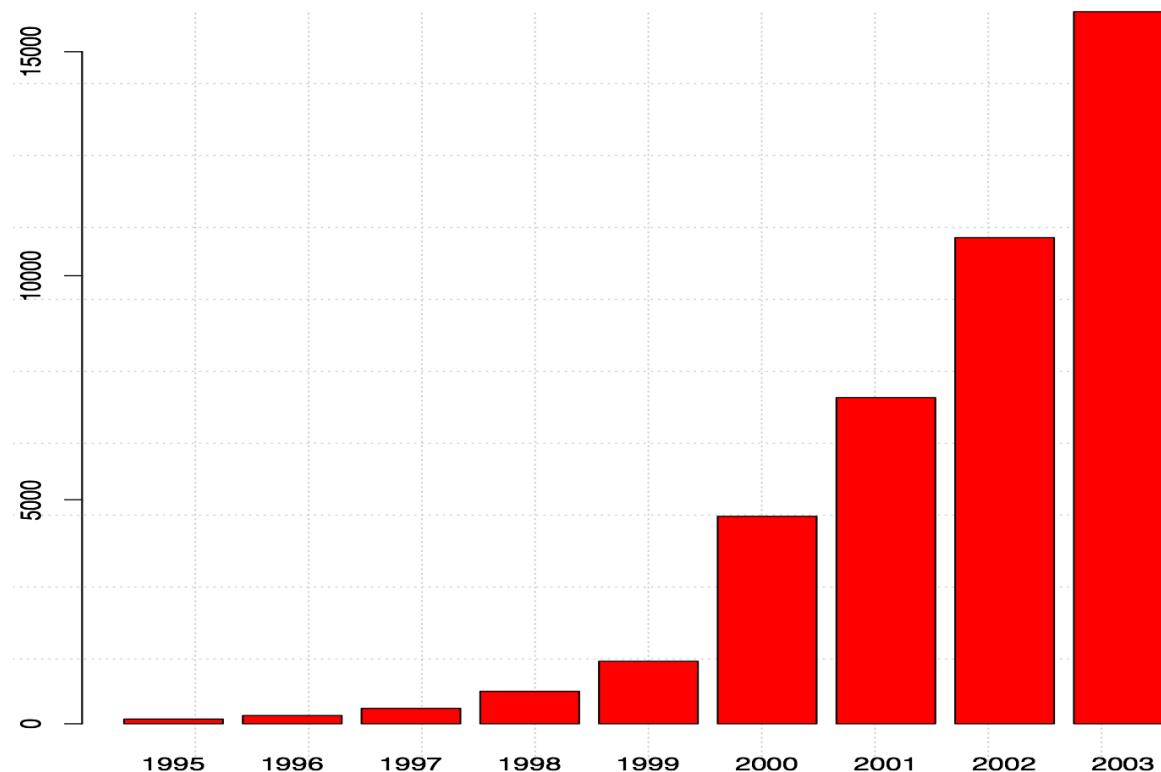
Includes several subfields: Machine Learning, Metaheuristics, ...



The Rise of Data

<http://www2.sims.berkeley.edu/research/projects/how-much-info-2003/>

How much new information is created each year?



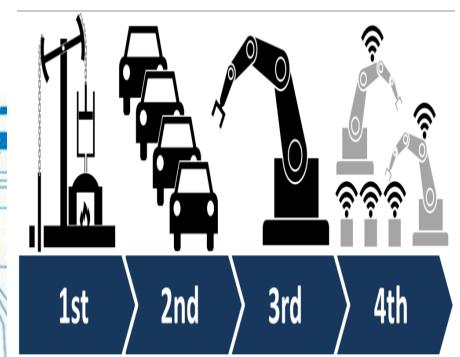
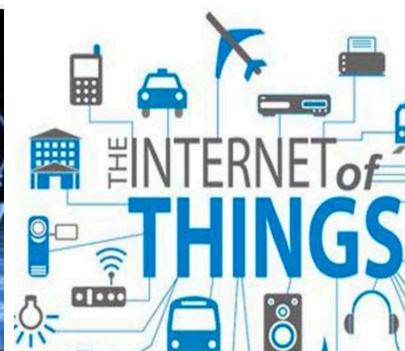
The Rise of Data

<https://techcrunch.com/2017/05/13/apple-acquires-ai-company-lattice-data-a-specialist-in-unstructured-dark-data/>

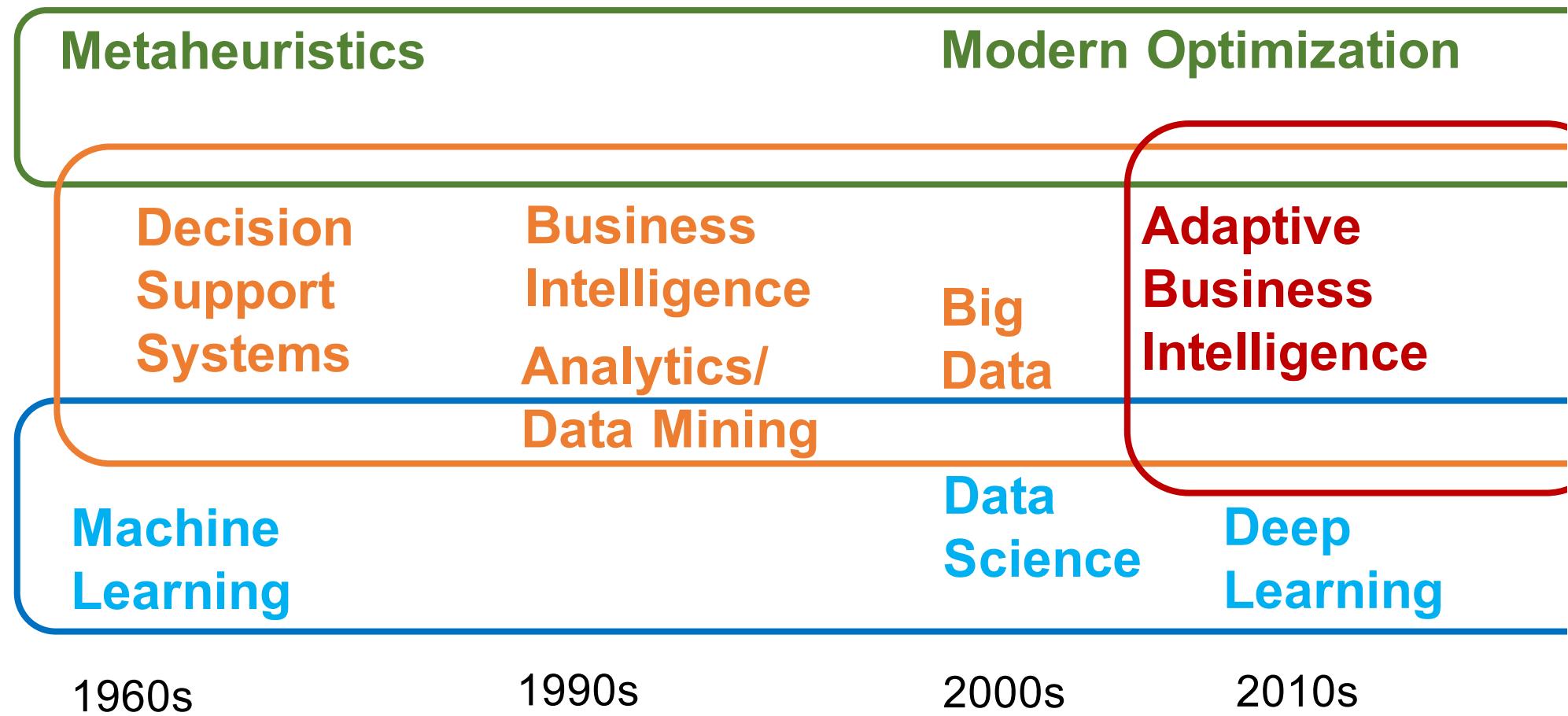
“4.4 zettabytes of data in 2013, and that’s projected to grow to 44 zettabytes by 2020, and IBM estimates that 90 percent of the data in existence today was produced in the last two years.”

Many sources of data, including

- Web & Social Networks.
- Internet of Things (IoT).
- Industry 4.0.
- Smart Cities.



Data Related Terms

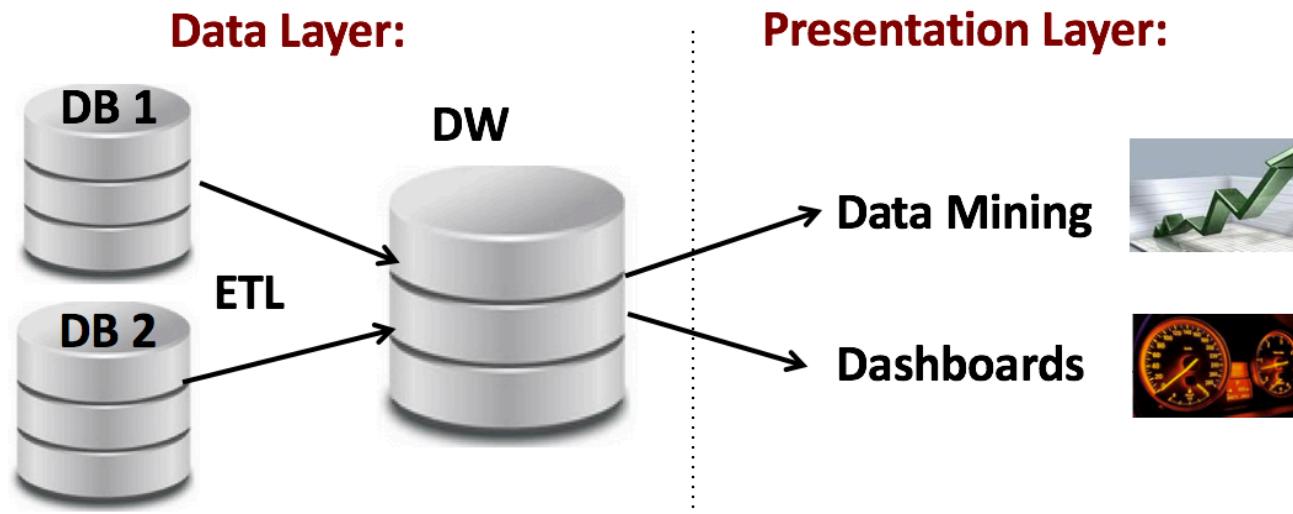


Business Intelligence (BI)

Overlaps with **Analytics, Decision Support Systems, Data Science**

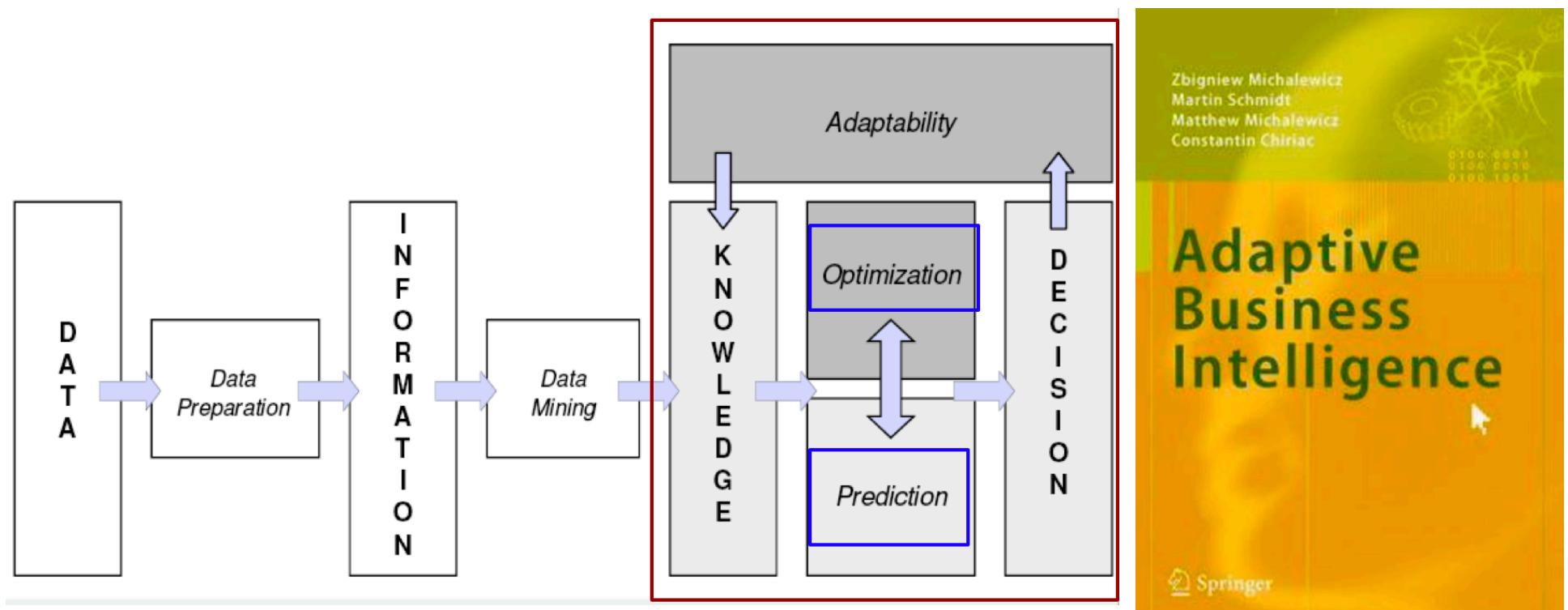
Umbrella term that includes architectures, tools, methods and databases, to analyze raw data in order to support decisions.

Can include: Data Warehouse (DW), Data Mining (DM) and Dashboards.



Adaptive Business Intelligence (ABI) (Michalewicz et al. 2006)

Adds intelligent adaptive modules to standard BI systems: Data-driven Prediction and Modern Optimization.



Rexer 2015 Data Science Survey

<http://www.rexeranalytics.com/data-science-survey.html>

1,220 analytic professionals from 72 countries.

Highlights:

- Regression, Decision Trees, and Cluster analysis remain the most commonly used algorithms in the field.
- The rise of the R tool: 76% of respondents report using R.

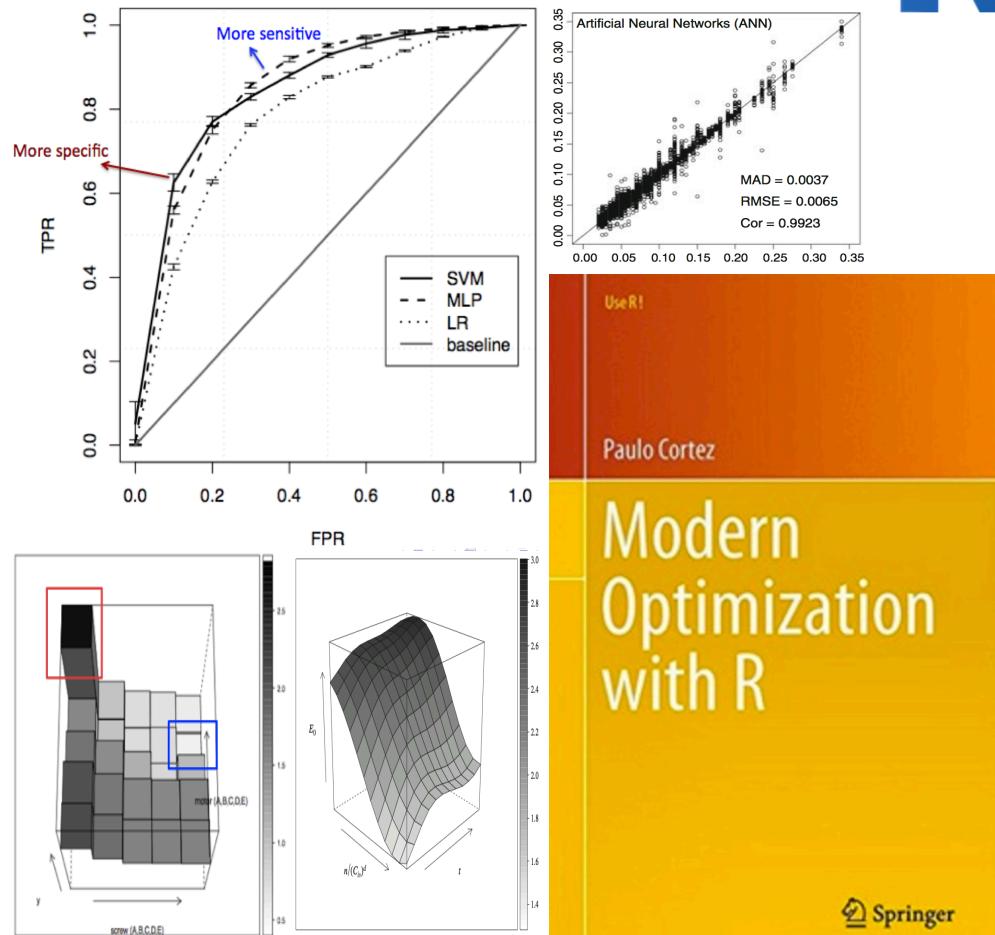
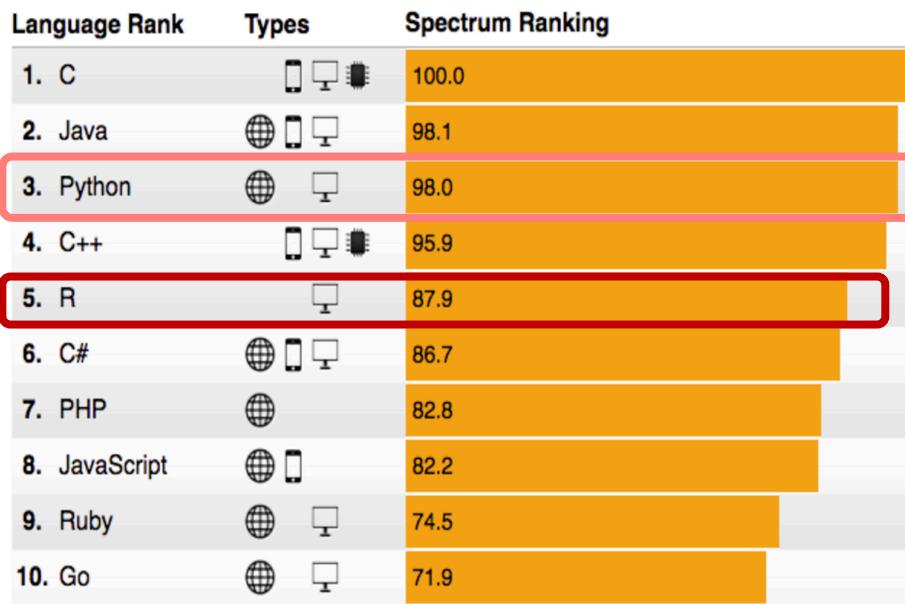


Open Source Tools: R

<http://www.r-project.org>



IEEE 2016 computer
language ranking:



Paulo Cortez

Modern
Optimization
with R

Springer

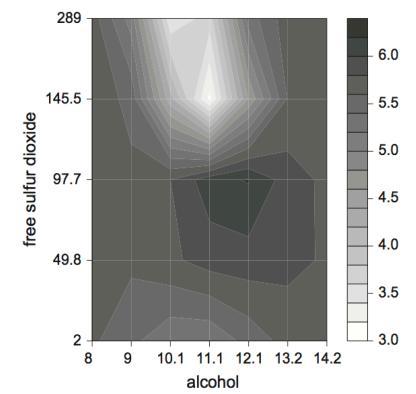
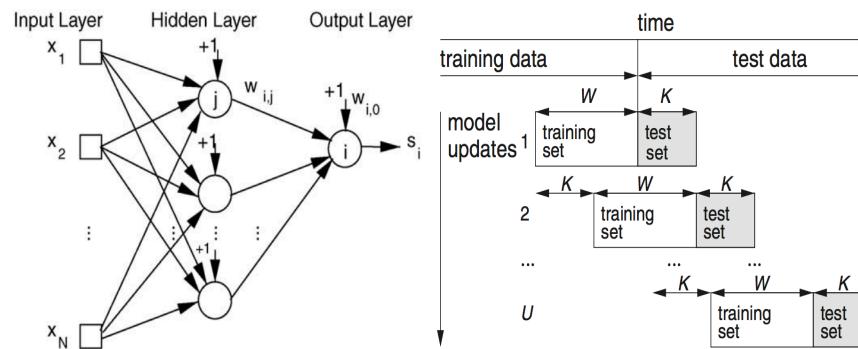
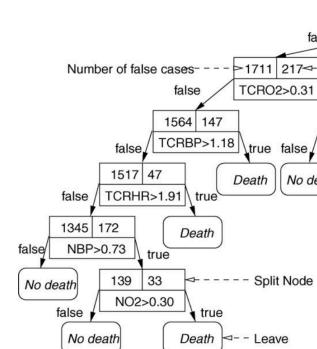
Data-driven Prediction



“The ultimate goal of data mining is **prediction** - and **predictive data mining** is the most common type of data mining and one that has the most direct business applications.”

<http://www.statsoft.com/textbook/data-mining-techniques>

Machine Learning: decision trees, neural networks, ensembles, random forests, support vector machines, deep learning, ...



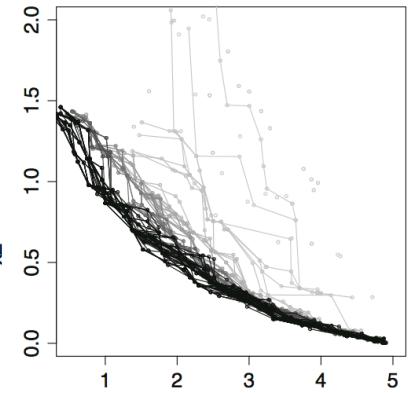
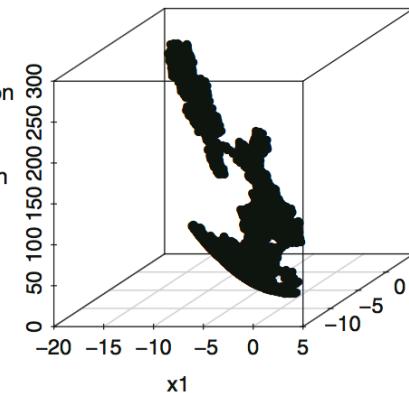
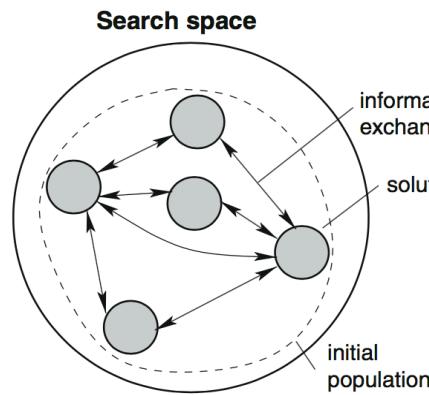
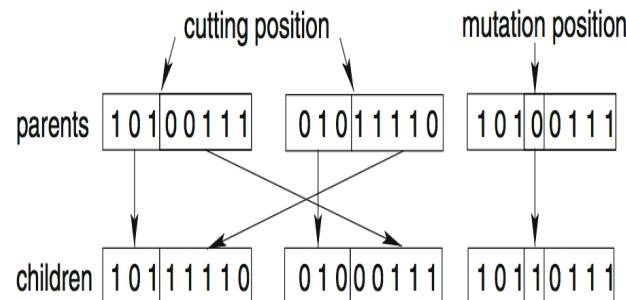
Modern Optimization

Also known as Metaheuristics



"Related with general purpose solvers that use few domain knowledge, iteratively improving a solution (or population of solutions) to minimize or maximize a goal." <http://www.springer.com/gp/book/9783319082622>

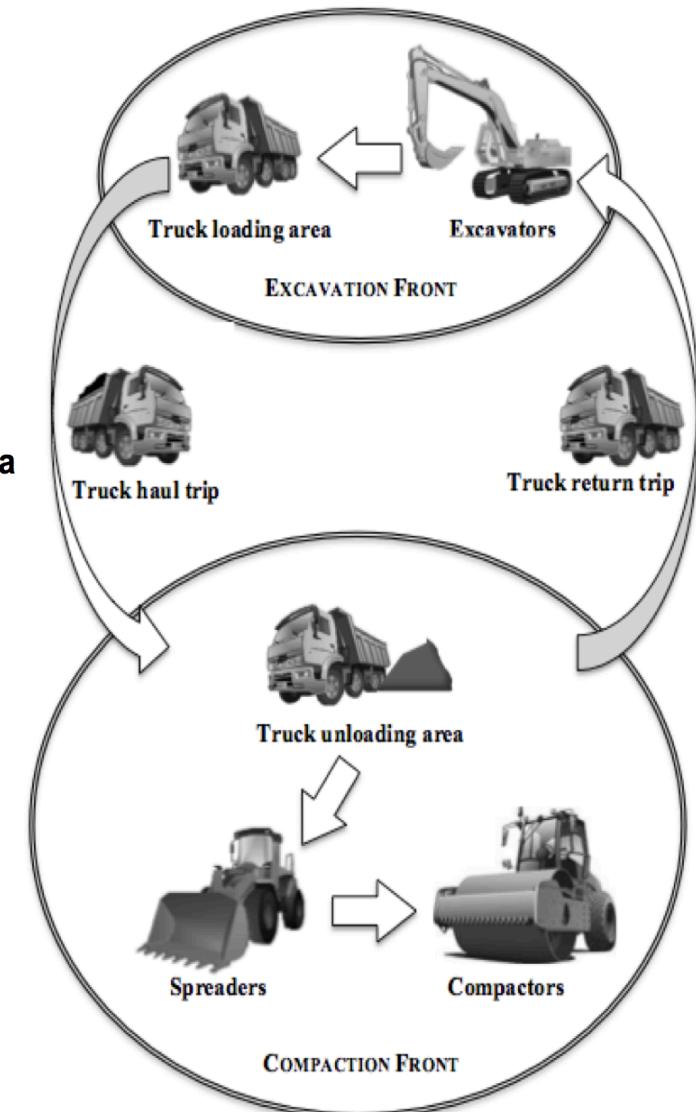
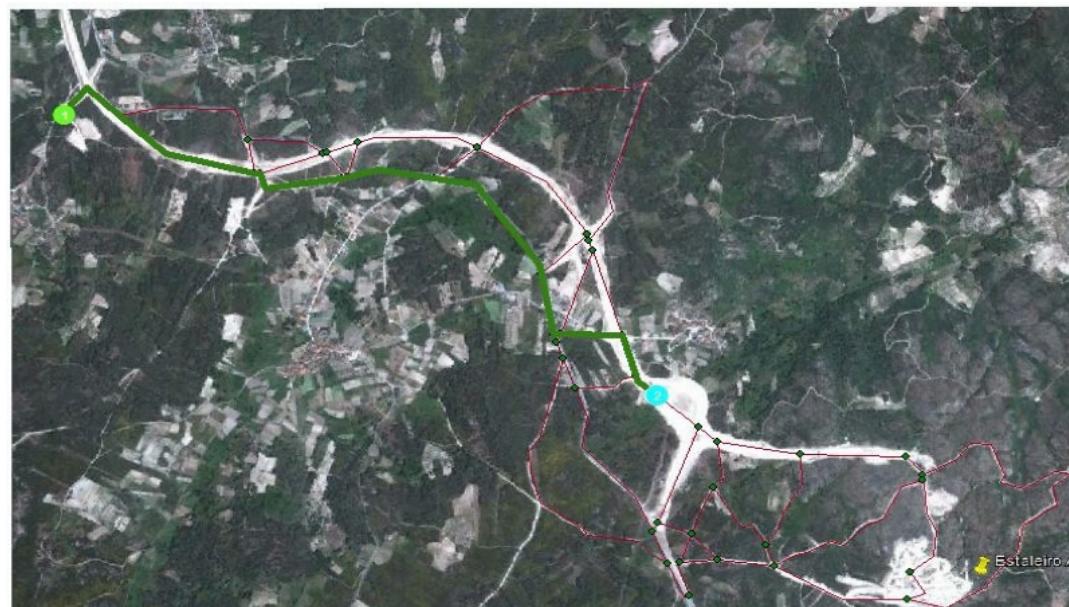
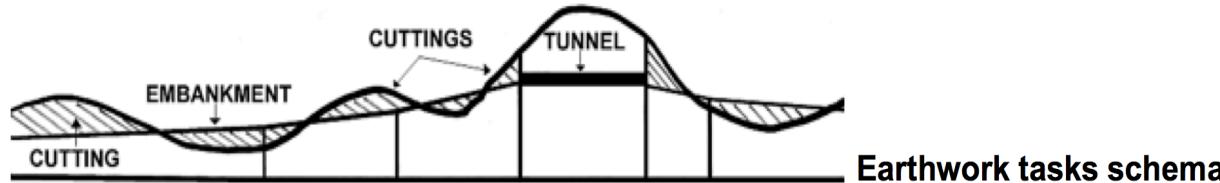
Metaheuristics: simulated annealing, tabu search, genetic algorithms, genetic programming, multi-objective optimization (e.g. NSGAII), particle swarm optimization, ...



Adaptive Business Intelligence : Application Examples

Design of Earthworks

Leveling or shaping of a target area: need to manage construction equipment

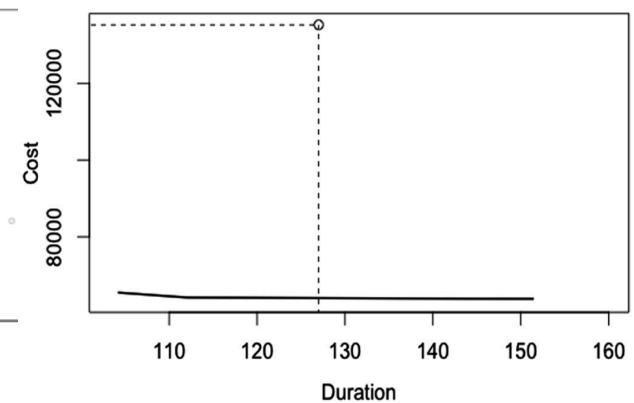
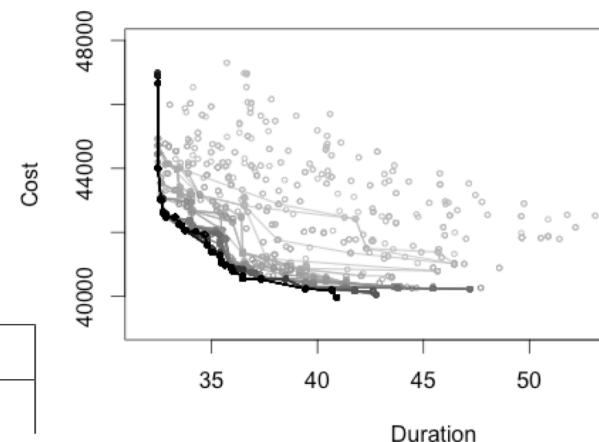
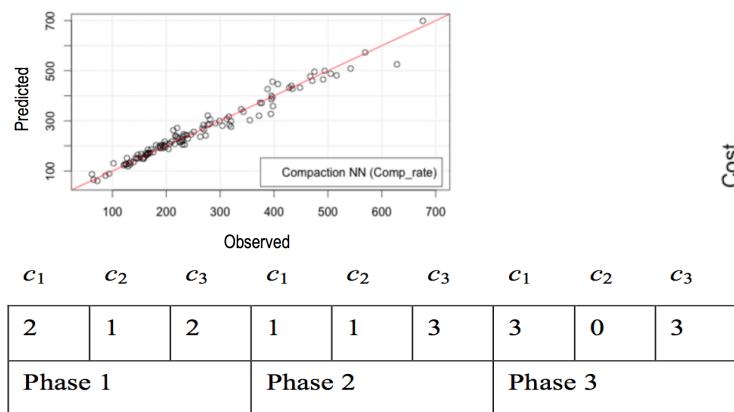


ABI approach:

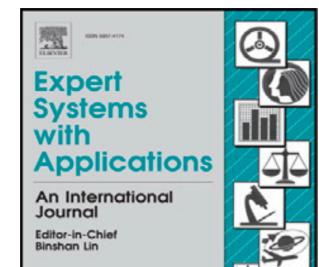


Prediction of compaction equipment conditions for a particular soil type (regression, Neural Network)

Optimization: Assigning compactors to embankment areas (multi-objective, NSGAII algorithm)



M. Parente, P. Cortez, A.G. Correia, An evolutionary multi-objective optimization system for earthworks, Expert System with Applications, 42:6674-6685 2015.



Design of Online News

Assisting users in the writing of online news: how to improve popularity?

Mashable ▾ SOCIAL MEDIA ▾ TECH ▾ BUSINESS ▾ ENTERTAINMENT ▾ WORLD ▾ LIFESTYLE ▾ WATERCOOLER ▾ VIDEO ▾ FOLLOW MASHABLE >

NEEDED #AppsforAll www.apple.com

Tech

Apple patent envisions fuel cell battery that could power a smartphone for weeks

1.4k SHARES / Share on Facebook Share on Twitter +

WHAT'S THIS?



IMAGE: FLICKR, KÄRLIS DAMBRĀNS

Quick, what's your No. 1 qualm about smartphones? Chances are, you said "battery life." Most smartphones today, even high-end ones, barely **last a day** of heavy use.



Mashable ▾ SOCIAL MEDIA ▾ TECH ▾ BUSINESS ▾ ENTERTAINMENT ▾ WORLD ▾ LIFESTYLE ▾ WATERCOOLER ▾

Paris will go car-free for a day in September to combat pollution



In an effort to curb the amount of air pollution and smog in the city, Paris will go car-free for one day this month.

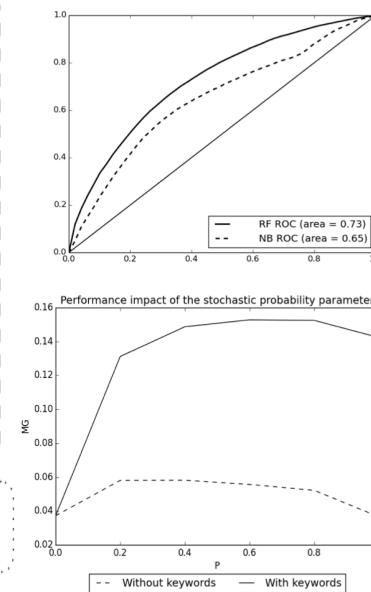
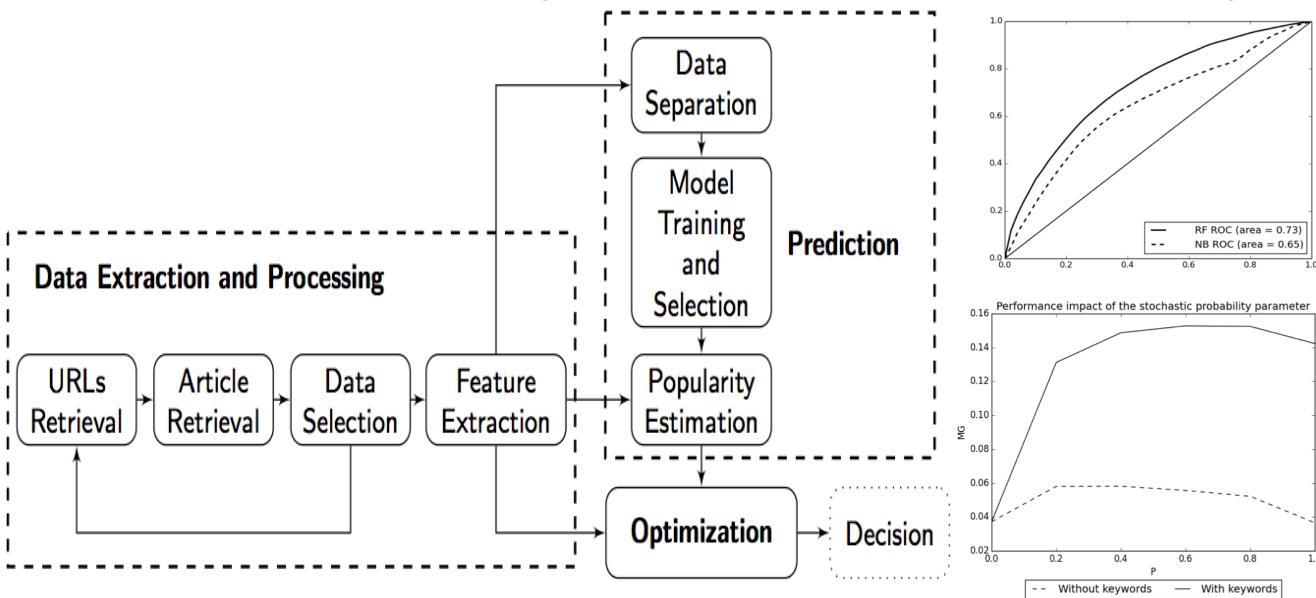
On Sept. 27, the streets of France's capital will be closed to motor vehicles from 11 a.m. to 6 p.m., with the exception of a few main thoroughfares, which will operate with speed limits of about 20 mph.



ABI approach:

Prediction of news shares based on text and multimedia features (classification, Random Forest)

Optimization: Searching for more popular news features (stochastic hill-climbing)



Online News Popularity Data Set
Download: [Data Folder](#), [Data Set Description](#)

Abstract: This dataset summarizes a heterogeneous set of features about articles published by Mashable in a period of two years. The goal is to predict the number of shares in social networks (popularity).



K. Fernandes, P. Vinagre and P. Cortez, A Proactive Intelligent Decision Support System for Predicting the Popularity of Online News, EPIA 2015.

Mobile Marketing: PROMOS – Prediction and optimization of advertising campaigns for mobile devices

Prediction and Optimization: Big Data, Classification, Modern Optimization

R&D Project Reference: NORTH-01-0247-FEDER-017497

Funded by Portugal 2020/Adi – Innovation Agency

Promoter Entity: OLAMOBILE

Co-promoter Entity: University of Minho

Investment: 730 KEUR

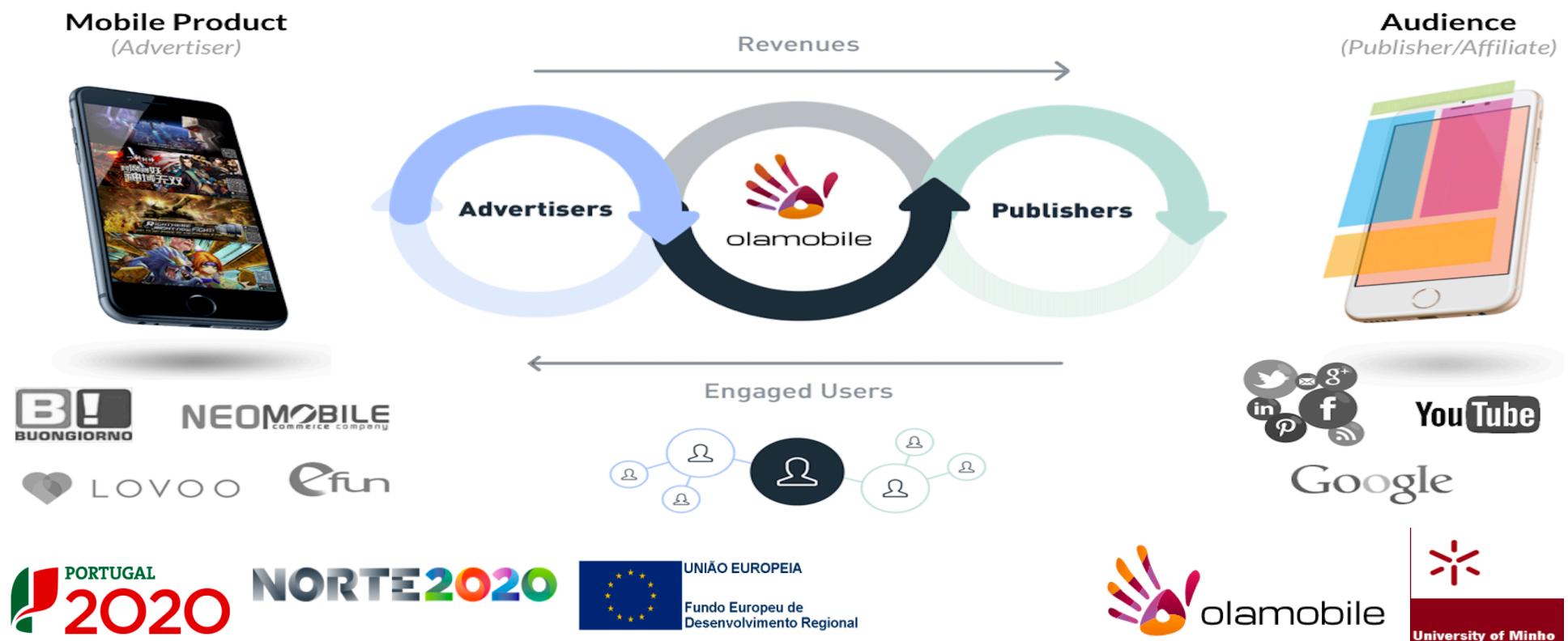
<http://promos.dsi.uminho.pt/>

<https://www.olamobile.com/pt/projeto-portugal-2020/>



Mobile Marketing: PROMOS – Prediction and optimization of advertising campaigns for mobile devices

Prediction and Optimization: Big Data, Classification, Modern Optimization





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Thank you!