European Commission

JRC CONFERENCE AND WORKSHOP REPORTS

Artificial Intelligence at the JRC

2nd workshop on Artificial Intelligence at the JRC, Ispra 5th July 2019

Editor: Stefano Nativi

2020

This publication is a Conference and Workshop report by the Joint Research Centre (JRC), the European Commission's science and knowledge service. It aims to provide evidence-based scientific support to the European policymaking process. The scientific output expressed does not imply a policy position of the European Commission. Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use that might be made of this publication.

Contact information
Stefano Nativi (Ed.)
European Commission, Joint Research Centre, TP262, Via Fermi, 21027 Ispra (VA), ITALY
stefano.nativi@ec.europa.eu
Tel.: +39 0332 785 075

EU Science Hub
https://ec.europa.eu/jrc

JRC120539

PDF ISBN 978-92-76-18943-5 doi:10.2760/511755

Luxembourg: Publications Office of the European Union, 2020.

The reuse policy of the European Commission is implemented by the Commission Decision 2011/833/EU of 12 December 2011 on the reuse of Commission documents (OJ L 330, 14.12.2011, p. 39). Except otherwise noted, the reuse of this document is authorised under the Creative Commons Attribution 4.0 International (CC BY 4.0) licence (https://creativecommons.org/licenses/by/4.0/). This means that reuse is allowed provided appropriate credit is given and any changes are indicated. For any use or reproduction of photos or other material that is not owned by the EU, permission must be sought directly from the copyright holders.

All content © European Union, 2020, except: page 32 (Pixabay), page 24 (Gstudio Group-Fotolia.com), page 16 (Photoman-Fotolia.com), page 8 (Mariusz Prusaczyk from Pexels), page 13 (Alex Knight from Pexels), page 20 (Lukas from Pexels), page 38 (rawpixel.com from Pexels), page 27 (Kaique Rocha from Pexels).

How to cite this report: Nativi S., Anastasakis K., Asturiol D., Balahur A., Barbaglia L., Baumann K., Beslay L., Bremer-Hoffmann S., Cardona M., Consoli S., Castillo C., Charisi V., Corbane C., d'Andrimont R., De Prato G., Deceuninck P., Delipetrev B., Devos W., Dottori F., Duch-Brown N., Ferrara P., Ferri S., Gómez E., Gómez-Losada A., Halamoda-Kenzaoui B., Halkia M., Hamon R., Hradec J., Jenkinson G., Junklewitz H., Kalas M., Kemper T., Lemoine G., Lopez Cobo M., Lorini V., Manzan S., Martinez Sanchez L., Martinez-Plumed F., Milenov P., Nai-Fovino I., Nappo D., Noce L., Papazoglou M., Petrillo M., Piovesan J., Puertas Gallardo A., Righi R., Rolland E., Sabo F., Salamon P., Samoili S., Sanchez I., Sanchez Belenguer C., Sequeira V., Soille P., Syrris V., Thomakos D., Tolan S., TMA-CC Team, Tosetti E., Van Damme M-S, van der Velde M., Vazquez-Prada Baillet M., Whelan M., Wittwehr C., Wolfart E., Worth A., Yordanov M., *2nd workshop on Artificial Intelligence at the JRC,* Nativi S. (Ed.), Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-18943-5, doi:10.2760/511755, JRC120539.

Contents

Foreword

AI (Artificial Intelligence) was first introduce as a generic term that refers to any machine or algorithm that is capable of observing its environment, learning, and based on the knowledge and experience gained, take intelligent actions or propose decisions. Autonomy of decision processes and interaction with other machines and humans are other dimensions that need to be considered.

Although many of the methodological developments in AI date back more than 50 years, the reason why we now pay so much attention to AI in general and leaning-based AI in particular is that the recent advances in digital technologies along with the enabled dataficiation of our Society have led to major breakthroughs in the last years. The capacity to benefit from, and adapt to, the challenges and opportunities presented by this cognitive revolution is arguably one of the greatest strategic issues facing the European Union.

According to the European Commission white paper on "Artificial Intelligence - A European approach to excellence and trust" (COM(2020) 65 final), *AI is a strategic technology that offers many benefits for citizens, companies and society as a whole, provided it is human-centric, ethical, sustainable and respects fundamental rights and values. AI offers important efficiency and productivity gains that can strengthen the competitiveness of European industry and improve the wellbeing of citizens. It can also contribute to finding solutions to some of the most pressing societal challenges, including the fight against climate change and environmental degradation, the challenges linked to sustainability and demographic changes, and the protection of our democracies and, where necessary and proportionate, the fight against crime*.

The Joint Research Centre, the European Commission's science and knowledge service, provides support on several important and complex matters, but also, plays an instrumental role in several key initiatives of the European Commission. In particular, AI & Big Data has been set up as one of the principal areas of interest of the Joint Research Centre.

List of authors

Konstantinos Anastasakis

David Asturiol

Alexandra Balahur

Luca Barbaglia

Kathrin Baumann

Laurent Beslay

Susanne Bremer-Hoffmann

Melisande Cardona

Carlos Castillo

Vicky Charisi

Sergio Consoli

Christina Corbane

Raphael d'Andrimont

Giuditta De Prato

Pierre Deceuninck

Blagoj Delipetrev

Wim Devos

Francesco Dottori

Blanka Halamoda-Kenzaoui

Matina Halkia

Ronan Hamon

Jiri Hradec

Gabriel Jenkinson

Henrik Junklewitz

Milan Kalas

Thomas Kemper

Guido Lemoine

Montserrat Lopez Cobo

Valerio Lorini

Sebastiano Manzan

Laura Martinez Sanchez

Fernando Martinez-Plumed

Pavel Milenov

Igor Nai-Fovino

Domenico Nappo

Lucia Noce

Riccardo Righi

Etienne Rolland

Filip Sabo

Peter Salamon

Sofia Samoili

Ignacio Sanchez

Carlos Sanchez Belenguer

Vitor Sequeira

Pierre Soille

Vasileios Syrris

Dimitrios Thomakos

Songul Tolan

TMA-CC Team

Elisa Tosetti

Marie-Sophie Van Damme

Marijn van der Velde

Miguel Vazquez-Prada Baillet

Maurice Whelan

Néstor Duch-Brown

Pasquale Ferrara

Stefano Ferri

Emilia Gómez

Álvaro Gómez-Losada

Michail Papazoglou

Mauro Petrillo

Jacopo Piovesan

Antonio Puertas Gallardo

Clemens Wittwehr

Erik Wolfart

Andrew Worth

Momchil Yordanov

Abstract

This document presents the contributions discussed at the second institutional workshop on Artificial Intelligence (AI), organized by the Joint Research Centre (JRC) of the European Commission. This workshop was held on 05th July 2019 at the premises of the JRC in Ispra (Italy), with video-conference to all JRC's sites. The workshop aimed to gather JRC specialists on AI and Big Data and share their experience, identify opportunities for meeting EC demands on AI, and explore synergies among the different JRC's working groups on AI.

In comparison with the first event, according to the JRC Director General Vladimír Šuchav, the activities and results presented in this second workshop demonstrated a significant development of AI research and applications by JRC in different policy areas. He suggested to think about replicating the event at the premises of diverse policy DGs in order to present and discuss the clear opportunities created by JRC activities.

After the opening speech by the JRC Director General Vladimír Šuchav, the research and innovation presentation were anticipated by two presentations by Alessandro Annoni and Stefano Nativi. The first presentation dealt with the results of one year of AI@JRC and six months of fully operational AI&BD community of practice[1]. The second presentation reported the results of the AI competences survey at JRC.

The research and innovation contributions consisted in flash presentations (5 minutes) covering a wide range of areas. This report is structured according to the diverse domain areas addressed by the presenters.

While the first part of the workshop was mainly informative, in the second part we collectively discussed about how to move on and evolve the AI&BD community of practice.

[1] https://webgate.ec.europa.eu/connected/groups/community-of-practice-ai-and-big-data

Introduction

This report summarizes the contributions presented at the second JRC workshop on Artificial Intelligence (AI), organized by the Artificial Intelligence and Big Data Community of Practice (AI&BD CoP).

The workshop, which was held on the 05th July 2019 in Ispra with all the other JRC sites connected online, gathered JRC researchers of different fields of science and technology whose expertise was related to AI and Big Data. The workshop agenda is included as Annex 1.

The main objectives of the workshop were:

1. To identify the ongoing current scientific application areas on AI and appreciate the progress those one already presented at the first workshop.
2. To explore opportunities and synergies between different JRC's working groups on AI.
3. To discuss the outcomes of one year of AI@JRC and six months of operational AI&BD Community of Practice.
4. To discuss about the future role of the AI@JRC CoP.

In this report, a fact sheet summarizes each presentation (i.e. scientific activity). They are grouped according to the policy area that is considered more relevant. The policy areas recognized by this reports largely stem from the recent Communications of the European Commission on a European Data Strategy, Artificial Intelligence, and Shaping Europe's Digital Future. Each policy area is briefly introduced including references to these Communications and other related publications.

Information covered by each fact sheet deal with: *AI Main Stream*, *Policy area* (or Background), main *Objectives* of the AI application, applied *Methodology*, and useful *References*, when applicable.

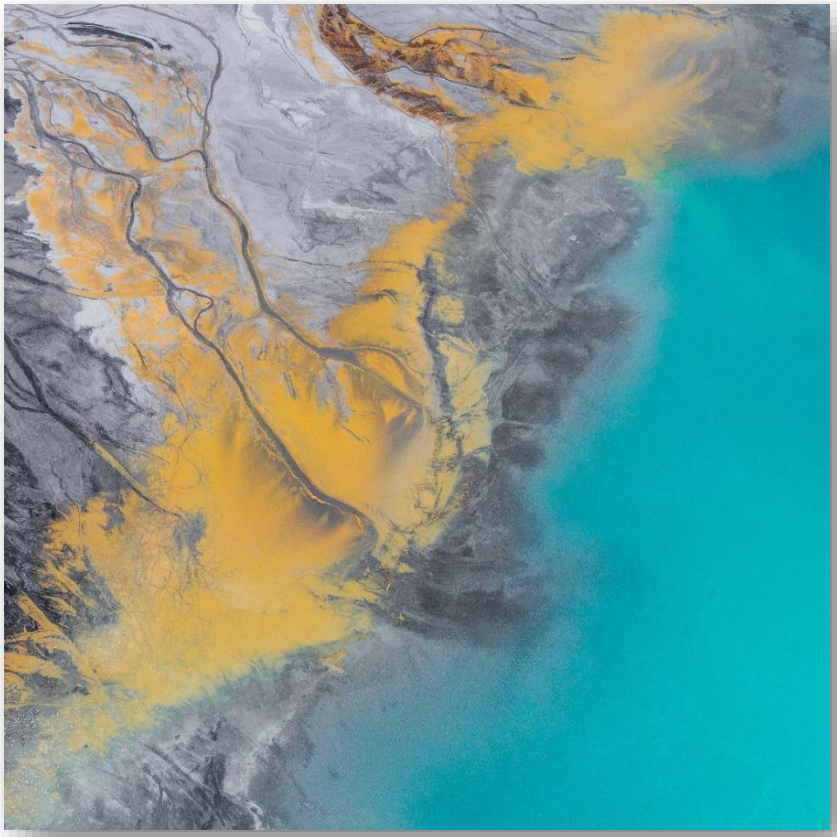
1 Green Deal

Climate change and environmental degradation are an existential threat to Europe and the world. To overcome these challenges, Europe needs a new growth strategy that transforms the Union into a modern, resource-efficient and competitive economy where: (a) there are no net emissions of greenhouse gases by 2050, (b) the economic growth is decoupled from resource use, and (c) no person and no place is left behind.

The European Green Deal is our roadmap for making the EU's economy sustainable. This will happen by turning climate and environmental challenges into opportunities across all policy areas and making the transition just and inclusive for all.

Digitalization will be key in reaching the ambitions of the European Green Deal and the Sustainable Development Goals. As powerful enablers for the sustainability transition, digital solutions can advance the circular economy, support the decarbonisation of all sectors and reduce the environmental and social footprint of products placed on the EU market.

In particular, the impact of AI systems must be carefully considered from the perspective of society as a whole. The use of AI systems can have a significant role in achieving the Sustainable Development Goals, and in supporting the democratic process and social rights. Digital technologies such as AI are a critical enabler for attaining the goals of the Green Deal. Besides, given the increasing importance of AI, the environmental impact of AI systems needs to be duly considered throughout their lifecycle and across the entire supply chain, e.g. as regards resource usage for the training of algorithms and the storage of data.



1.1 AI for updating the European Settlement Map from Copernicus Very High Resolution

Corbane Christina, Sabo Filip, Kemper Thomas (Global Human Settlement Layer)

Main AI Stream

Computer Vision: AI for updating the European Settlement Map from Copernicus Very High Resolution Satellite Data

Policy areas and legal reference

- New Urban Agenda of Habitat III, The Urban Agenda for the EU[2][3]

Objectives

- Assess the added-value of Deep Learning models for updating the new European Settlement Map.
- Analyse the complimentary between the Symbolic Machine Leaning SML (in-house machine learning method) and U-net model for discriminating building types from Copernicus Pan-European coverage of Very High Resolution (VHR) satellite data.

Methodology

Comparing outputs from SML trained with Enhanced Corine Landcover and U-Net architecture trained with detailed building footprints shared by IGN France to assess the complementarity of the two models for improved detection of single buildings in VHR data and for deriving building typologies

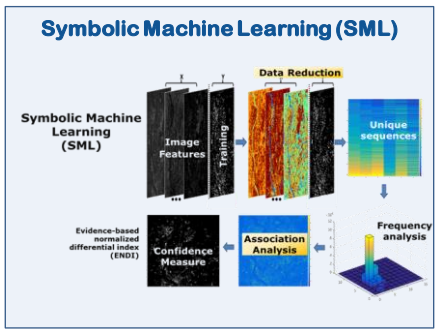
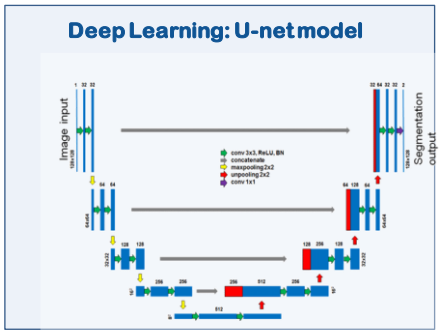


Figure. Discrimination of industrial buildings



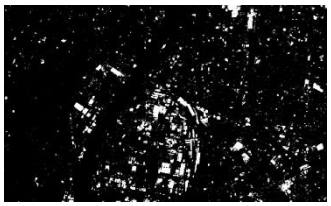


Figure. Identification of single buildings

Scientific references

- Corbane, C., Sabo, F. Syrris, V., Kemper, T., Politis, P., Pesaresi, M., Soille, P. and Osé, K. , "Application of the Symbolic Machine Learning to Copernicus VHR Imagery: The European Settlement Map", IEEE Geoscience and Remote Sensing Letters, doi: 10.1109/LGRS.2019.2942131

[2] http://habitat3.org/the-new-urban-agenda
[3] https://ec.europa.eu/futurium/en/urban-agenda-eu/what-urban-agenda-eu

1.2 Machine learning for Multi-Class Segmentation of Sentinel-2 Imagery

Blagoj DELIPETREV

Main AI Stream

Deep learning/machine learning, Image recognition

Policy areas and legal reference

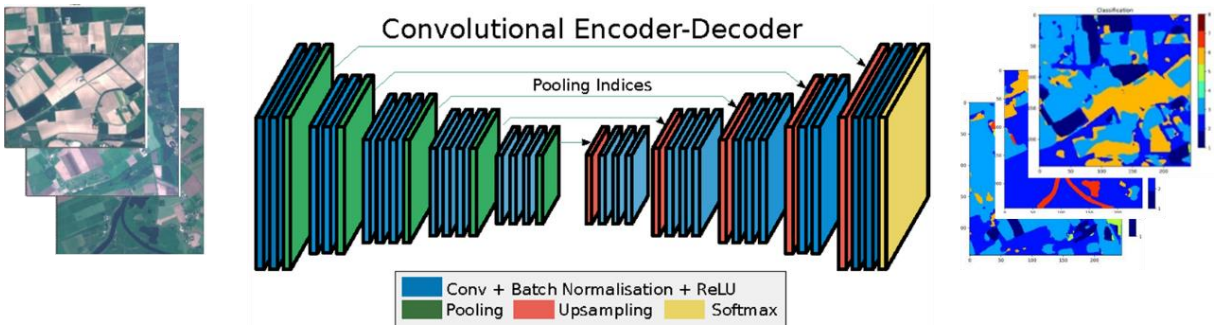
- Directive 2007/2/EC (OJ L 108, 25.4.2007): establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)
- Regulation (EU) No 377/2014 (OJ L 122, 24.4.2014): establishing the Copernicus Programme and repealing Regulation (EU) No 911/2010

Objectives

Machine learning (ML) to create new data and fill data gaps from Sentinel satellite imagery and geospatial/cadastral datasets. The presented solution can:

- Fill gaps and generate data.
- Detect changes and update base cadastral maps based on remote sensing.
- Improve overall data quality.

Methodology



Scientific references

- Syrris, V., Hasenohr, P., Delipetrev, B., Kotsev, A., Kempeneers, P., & Soille, P. (2019). Evaluation of the Potential of Convolutional Neural Networks and Random Forests for Multi-Class Segmentation of Sentinel-2 Imagery. *Remote Sensing*, *11*(8), 907.
- ML showcase on JEODPP platform, available at: https://cidportal.jrc.ec.europa.eu/services/webview/jeodpp/ml-showcase/

1.3 Big Data Analytics (BDA)

Vasileios Syrris and Pierre Soille

Main AI Stream

Machine learning / Deep learning / Computer vision / Image analysis / Earth Observation & Geospatial Big Data Analytics.

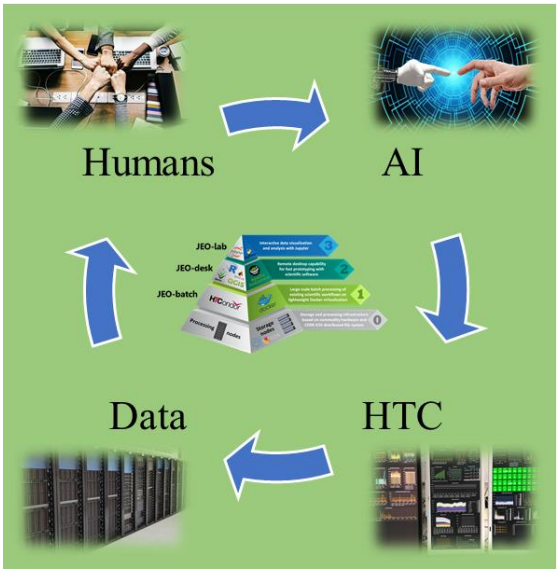
Policy areas and legal reference

- EU Space policy (DEFIS)
- EU Data driven economy (CNECT and RTD)
- DEVCO, REGIO, ENV, CLIMA, AGRI, ECHO, ENER, SANTE, and MARE policies

Objectives

- Setting up of a JRC platform for multi-petabyte scale data storage, management, processing, and analysis while fostering data/knowledge sharing & collaborative working;
- Fulfilling the needs of the JRC Knowledge Production and Management units as well as partners from within the Commission and beyond, for resolving complex problems;
- Providing services on Big Data management;
- Providing expertise on Big Data analysis by means of pattern recognition, statistical and artificial intelligence approaches.

Methodology



Alignment with the JRC principles and values of ***fairness***, ***cooperation*** and ***transparency***.

- Types of models: deep and shallow neural networks, decision trees, kernel-based and support vector machines, probabilistic/Bayesian models, filters, linear/non-linear regressors, ensembles, etc.;
- CERN EOS distributed file system;
- Collaborative working environment: GitLab, wiki, cloud services;
- Trainings, workshops, publications and active contributions to big data events like the "Big Data from Space" conference;
- Open science: reproducible scientific workflows via Jupyter notebooks and documented data sets;
- Knowledge acquisition and expertise preservation through the storing and automatic activation of full algorithmic workflows;
- More than 50 use cases (17 JRC units and 8 Directorates); more than 300 active users;
- Participation to openEO and CS3MESH4EOSC projects (led by TU-Wien & CERN resp.).

Scientific references

- A versatile data-intensive computing platform for information retrieval from big geospatial data (2018), doi: 10.1016/j.future.2017.11.007
- Evaluation of the Potential of Convolutional Neural Networks and Random Forests for Multi-Class Segmentation of Sentinel-2 Imagery (2019), doi: 10.3390/rs11080907
- Proceedings of the 2019 conference on Big Data from Space. AI&Policy@AMLD'20.

1.4 Artificial Intelligence for Directorate F

Mauro Petrillo and Antonio Puertas-Gallardo

Main AI Stream

Machine learning / Deep learning; Natural language processing; Speech to text conversion; Context aware computing; Text mining; Video automatic content recognition

Policy areas and legal reference

- Digital Single Market COM(2015) 192 final.

Objectives

The objective is to explore the use of AI in order to:

- perform unbiased analyses of scientific literature; (Obj.1)
- make unbiased mapping of JRC scientific competences; (Obj.2)
- get concepts and messages from speeches without introducing bias; (Obj.3)

Methodology

- Design and implementation of AI-based workflows to process large sets of literature references. This approach has been used by the EC Scientific Advice Mechanism's High Level Group (SAM HLG) of Scientific Advisors in managing results of literature searches of three reports, and by our Unit to write a review on of micro- and nanoplastic contamination in the food chain
- Design and implementation of a system able to map JRC scientific knowledge. By analysing the published output produced by JRC staff during their whole career with natural language processing tools, relevant keywords are extracted from each of the published documents, combined, and mapped to established thesauri (each specialised for a specific purpose) in order to harmonise the nomenclature and eliminate non-relevant keywords. The information produced is stored in a database, a web-based application (JRC-SCOMAP, https://jrcscomap.jrc.cec.eu.int/jrc_scomap) has been developed and it is regularly used, also in support to commissioners.
- As proof of concept, we have applied tools based on automated machine learning and algorithms for understanding speeches to provide unbiased summaries of them. These summaries, if properly traced over time, can reveal trends communicative shifts and can anticipate needs and issues to be approached or tackled.

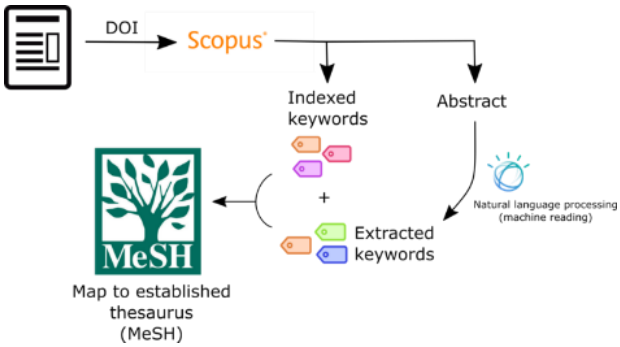


Figure. The automatic workflow developed to process large sets of literature references

Scientific references

- JRC technical report “Clustering and classification of reference documents from large-scale literature searches: Support to the SAM explanatory note "New Techniques in Agricultural Biotechnology"”, EPO, 2017, doi:10.2760/256470.
- SAM report “EU authorisation processes of Plant Protection Products”, EPO, 2018, doi:10.2777/238919.
- RTD report “Microplastic Pollution The Policy Context”, EPO, 2018, doi:10.2777/998601.
- Toussaint B, Raffael B, Angers-Loustau A, et al. Review of micro- and nanoplastic contamination in the food chain. Food Addit Contam Part A Chem Anal Control Expo Risk Assess. 2019, doi:10.1080/19440049.2019.1583381

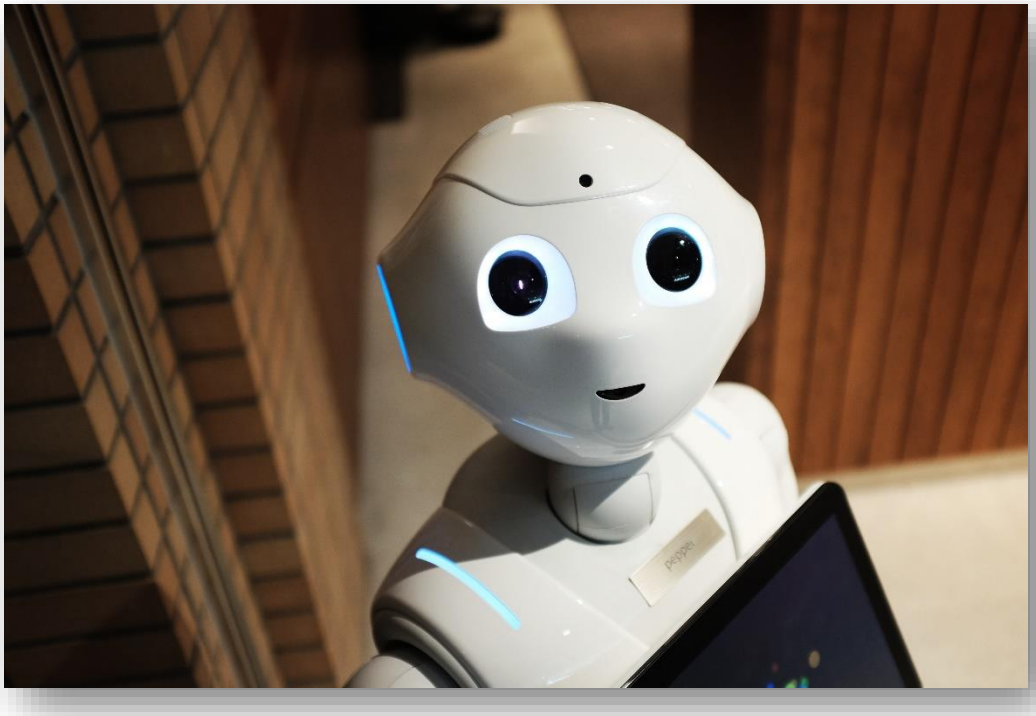
2 Industry and Manufacturing

Industry is one of the pillars of the European economy – the manufacturing sector in the European Union accounts for 2 million enterprises, 33 million jobs and 60% of productivity growth. We stand on the brink of a new industrial revolution, driven by new-generation information technologies such as the Internet of Things (IoT), cloud computing, big data and data analytics, robotics and 3D printing. They open new horizons for industry to become more adventurous, more efficient, to improve processes and to develop innovative products and services. Recent studies estimate that digitisation of products and services can add more than EUR 110 billion of annual revenue to the European economy in the next five years.

European industry is strong in digital sectors such as electronics for automotive, security and energy markets, telecom equipment, business software, and laser and sensor technologies. Europe also hosts world-class research and technology institutes. However, high-tech sectors face severe competition from other parts of the world and many traditional sectors and small and medium enterprises (SMEs) are lagging behind. There are also large disparities in digitisation between regions.

ICT-based solutions applied across the manufacturing value chain help to make processes more efficient. They enable the creation of more personalised, diversified and mass-produced products as well as flexible reaction to market changes. Big Data analytics, machine learning and other technologies provide important opportunities for the whole economy. The collection of data is now part of business processes across industries and sectors. However, the use of data remains limited in many organisations. This prevents innovation actors (SMEs and startups included) to benefit from data re-use in the development of new products and services or the training of AI applications.

Energy sustainability will also be essential, reducing resource consumption and waste generation to make the sector ready for the low-carbon economy.



2.1 Competing for Amazon's BuyBox: a machine learning approach

Álvaro Gómez-Losada and Néstor Duch-Brown

Main AI Stream

Machine learning

Policy areas and legal reference

- Digital single market and consumer protection.
- Regulation (EU) 2019/1150 (*OJ L 186, 11.7.2019, p. 57–79*) on promoting fairness and transparency for business users of online intermediation services (Platform to Business -P2B- Regulation).
- Directive 2011/83/EU (OJ L 304, 22.11.2011, p. 64–88) on consumer rights.

Objectives

- To study the empirical behavior of the buy-box to understand relevant features by which Amazon selects a given seller among competitors to occupy the buy-box

Methodology

A key feature of the Amazon marketplace is that multiple sellers can sell the same product. In such cases, Amazon recommends one of the sellers to customers in the so-called 'buy-box'. In this study, the dynamics among sellers for occupying the buy-box were modelled using a classification approach. Italy's Amazon webpage was crawled during ten months and features from products analysed to estimate the more relevant ones Amazon could consider for a seller occupy the buy-box. Predictive models showed that the more relevant features are the ratio between consecutive prices in products and their number of assessment received by customers.

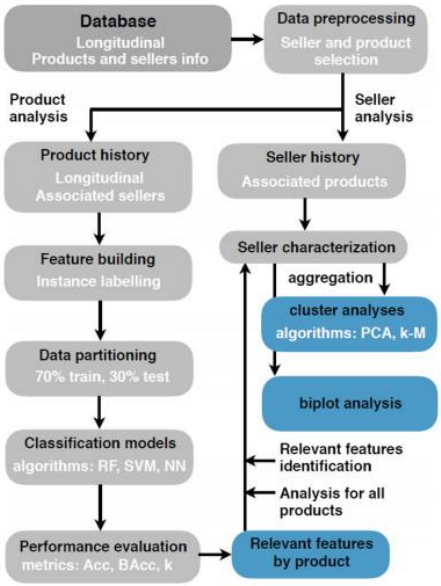


Figure. Methodology and analyses performed

Scientific references

- Gómez-Losada, A., Duch-Brown, N., 2019. Competing for Amazon BuyBox: a machine learning approach, in W. Abramowicz and R. Corchuelo (eds.), Business Information Systems. Seville, 26-28 June, 2019. Cham: Springer International Publishing, pp. 445-456. Available at: https://link.springer.com/chapter/10.1007%2F978-3-030-36691-9_38

2.2 The occupational impact of AI

Fernando Martínez-Plumed, Songül Tolan, Annarosa Pesole, Enrique Fernández-Macías, Emilia Gómez

Main AI Stream

AI evaluation

Policy areas and legal reference

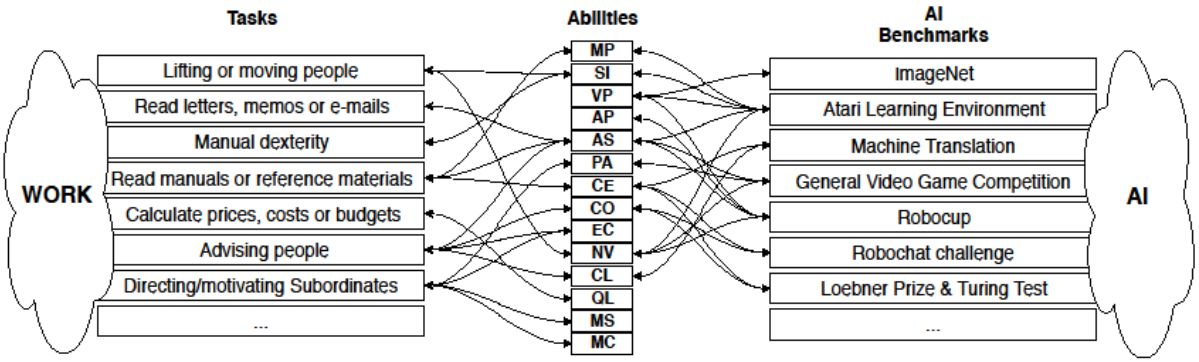
- Impact of Artificial Intelligence on employment

Objectives

- In this scenario we develop a framework for the analysis of the impact of AI on occupations within the labour market as proposed in Fernández-Macías et al., (2018) . We link occupations, defined in terms of tasks, to AI progress through an intermediate layer of cognitive abilities.
- We use the AIcollaboratory repository on AI benchmarking initiatives to identify variations in research activity in different AI topics to approximate future expected progress. On the work-related side we identify variations in task performance across occupations by combining three international datasources that contain information on tasks . Finally, we link this information by mapping both sides to cognitive abilities.
- This framework gives insights into AI's impact on occupations that goes beyond mere workplace automation by further identifying the abilities which are most likely going to be performed by AI. Moreover, it enables the simulation of multiple scenarios in which advancements in different AI areas can have different transformative effects on occupations.

Methodology

No ML method. Gathering of AI performance and work content indicators



Scientific references

- Fernández-Macías, E., Gómez, E., Hernández-Orallo, J., Loe, B. S., Martens, B., Martínez-Plumed, F., & Tolan, S. (2018). A multidisciplinary task-based perspective for evaluating the impact of AI autonomy and generality on the future of work. arXiv preprint arXiv:1807.02416.
- [A]I Collaboratory: an AI Watch initiative, available at: http://www.AICollaboratory.org
- PIAAC (Programme for the International Assessment of Adult Competencies), EWCS (Eurofound's European Working Conditions Survey) and O*NET (Occupational Information Network)
- Martínez Plumed, F., Tolan, S., Pesole, A., Hernández Orallo, J., Fernández-Macías, E., & Gómez, E. (2020). Does AI Qualify for the Job? A Bidirectional Model Mapping Labour and AI Intensities. Third AAAI/ACM conference on Artificial Intelligence, Ethics and Society, New York.

3 Health

Health data and data management are crucial when it comes to empowering citizens and building a healthier society. Artificial Intelligence will change our lives by improving healthcare, for example, by making diagnosis more precise and enabling better prevention of diseases). Better access to health data can significantly support the work of regulatory bodies in the healthcare system, the assessment of medical products and demonstration of their safety and efficacy. Health is an area where the EU can benefit from the data revolution, increasing the quality of healthcare, while decreasing costs.

The European Commission adopted a Communication and a Staff Working Document on Digital transformation of health and care in the Digital Single Market to boost European Union action. The first priority of the Communication focuses on citizens' secure access to their health data, also when they are abroad. The goal is to make it possible for citizens to exercise their right to access their health data across the EU, including, inter alia, the interoperability of Electronic Health Record (EHR) systems.

The second priority of the Communication stresses the importance of personalised medicine through shared European data infrastructure. Researchers and other professionals should pool resources (data, expertise, computing processing and storage capacities) across the EU, for better health prevention, faster and more personalised diagnosis and treatment. In order to achieve this, authorities and other stakeholders share data and infrastructure for prevention and personalised medicine research and treatment.

Finally, the third priority targets the empowerment citizens with digital tools for user feedback and person-centred care. This empowers people to look after their health, stimulating prevention, and enabling feedback and interaction between users and healthcare providers.

3.1 Validation of AI models for health and chemical safety

David Asturiol, Andrew Worth, Maurice Whelan

Main AI Stream

Machine learning

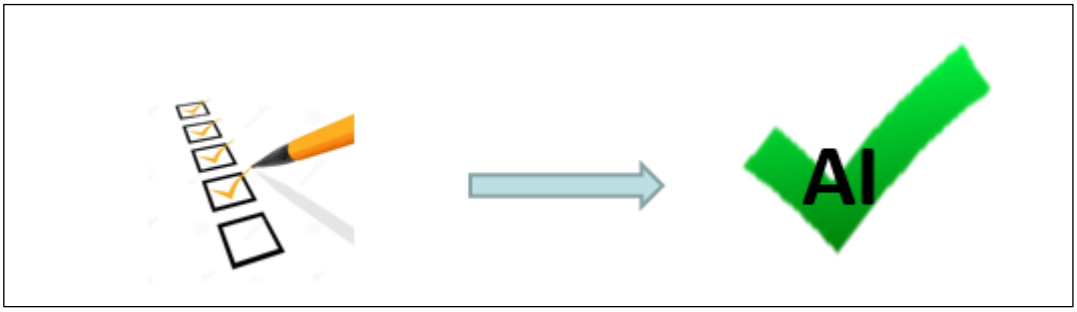
Policy areas and legal reference

- Health and consumer protection.
- Chemical safety.
- Alternatives to animal testing and 3Rs.

Objectives

- To define a strategy/standards to assess whether AI models are valid to be used in the context of health and chemical safety:
- To determine minimum requirements of transparency (datasets, model, optimization parameters, etc.)
- To define appropriate measures of goodness-of–fit, robustness and predictivity (e.g. R^2, cross-validation, RMSE, AUC, …)
- To define standard measures of uncertainty quantification (e.g. sensitivity analysis)
- To define minimum requirements of explainability (e.g. LIME, SHAP)
- To define standards for characterising the model applicability domain
- To define an AI model reporting standard

Methodology



Scientific references

- OECD. (2004). OECD principles for the validation, for regulatory purposes, of (quantitative) structure-activity relationships models.
- Wittwehr, C., Blomstedt, P., Gosling, J. P., Peltola, T., Raffael, B., Richarz, A. N., Sienkiewicz, M., Whaley, P., Worth, A., & Whelan, M. (2020). Artificial Intelligence for chemical risk assessment. *Computational Toxicology*, *13*(November 2019), 100114. https://doi.org/10.1016/j.comtox.2019.100114
- High-Level Expert Group on AI. (2019). Ethics Guidelines For Trustworthy Artificial Intelligence. 39. https://ec.europa.eu/digital-single-market/en/news/ethics-guidelines-trustworthy-ai
- EU Commission. *White Paper On Artificial Intelligence - A European approach to excellence and trust*. COM(2020) 65 final

3.2 AI for Chemical Risk Assessment (AI4CRA)

Clemens Wittwehr, Pierre Deceuninck, Andrew Worth, Maurice Whelan

Main AI Stream

Recommendations engine and collaborative filtering

Policy areas and legal reference

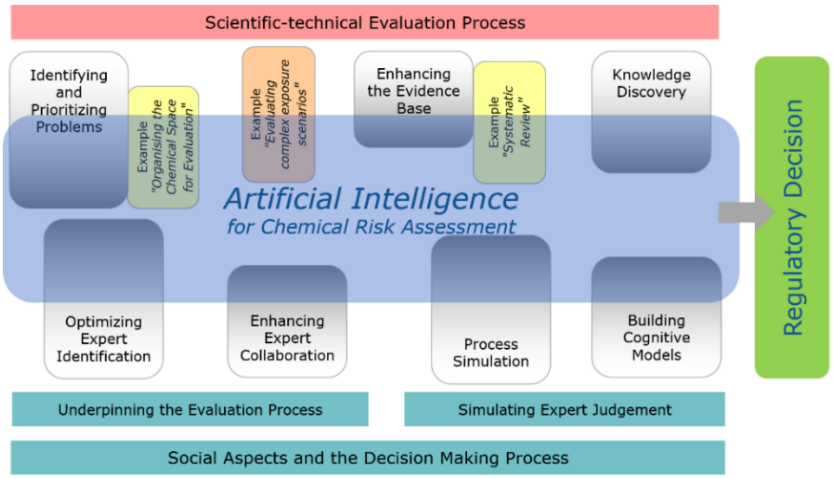
- Chemical safety; protection of animals used for scientific purposes.

Objectives

- Chemical Risk Assessment (CRA) is a discipline at the science-policy interface that informs far reaching decisions about the placing of chemical compounds onto the market, thereby having a significant impact on a multi-billion industry, the health of hundreds of millions of people and the condition of the environment;
- There are too many chemicals on the market and not enough (human) resources to properly assess all of them;
- Objective is to explore ways how Artificial Intelligence (AI) can support or improve CRA decisions and increase public trust in these decisions.

Methodology

International CRA and AI experts came together in a workshop at JRC to discuss how AI can lead to better regulatory decisions. The workshop concluded that *both* the scientific-technical evaluation *and* the social aspects of the decision-making process can be supported by AI. This includes straightforward aspects like identification of experts outside the usual circles, as well as help in the heavy-lifting of tedious systematic reviews, but also suggestions to analyse human expert decision making and highlighting shortcomings there by simulating the relevant cognitive models. International collaboration to follow up on our suggestions published in the paper cited below is currently being established.



Scientific references

- Wittwehr, C., Blomstedt, P., Gosling, J. P., Peltola, T., Raffael, B., Richarz, A. N., Sienkiewicz, M., Whaley, P., Worth, A., & Whelan, M. (2020). Artificial Intelligence for chemical risk assessment. Computational Toxicology, 13(November 2019), 100114. https://doi.org/10.1016/j.comtox.2019.100114

3.3 Can AI support the regulation of innovative health products?

B.Halamoda-Kenzaoui, E.Rolland, A.Puertas Gallardo, J. Piovesan, S.Bremer-Hoffmann

Main AI Stream

- Natural Language processing and text mining.
- Applications of nanotechnology in the medical sector are growing and new sophisticated drug delivery systems, advanced tissue engineering and new biosensing/diagnosis techniques are expected aiming to tackle unmet medical needs such as cancer or antimicrobial resistance.

Policy areas and legal reference

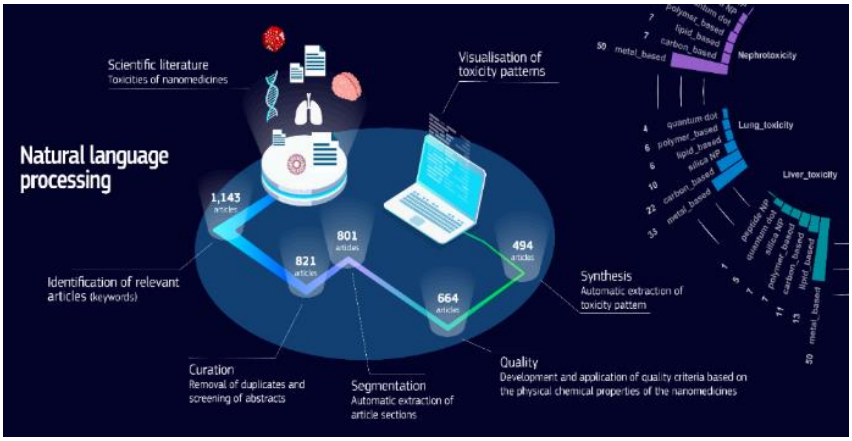
- Realisation of Europe's Beating Cancer plan and the EU action plan on antimicrobial resistance.
- Implementing the legal and regulatory frameworks on **medical devices (Regulation EU/2017/745)** and **medicinal products (Directive 2001/83/EC)** with the necessary knowledge on potential safety issues associated with these emerging product classes.

Objectives

- The lack of experience in regulating innovative health products often leads to uncertainties for decision makers and product developers on the required product characterisation. This situation can hamper a smooth translation of such urgently needed products to clinical applications. However, the exploitation of new technologies such as nanotechnology is usually associated with high publication rates in the scientific literature. In the recent study we would like to explore Natural Language Processing and text mining tools in order to:
  - apply quality criteria to the identified publications
  - extract information on toxicities triggered by the different categories of nanomedicines in order to identify weak signals on safety issues in the scientific literature
  - understand the applicability of text mining tools for systematic reviews of the scientific literature

Methodology

Following the approach of a systematic review, the study combines existing open access tools (Pubmed MeSH, reference managers, abstract screening tools) with a new exploratory tool based on Natural Language Processing for the article segmentation and the extraction of information. The tool was developed using R and depend among other on the NLP package Udpipe and another dependency in c++ to read the fonts of the pdf. The downstream analysis were done with the ggplot2 visualization package. More than 1000 publications were identified and curated followed by a quality evaluation of 664 publications according to predefined criteria. Finally, various toxicity effects were automatically screen from this 494 publications.



Scientific references

- Minimum information reporting in bio–nano experimental literature (https://www.nature.com/articles/s41565-018-0246-4)
- SWIFT-Review tool: https://www.sciome.com/swift-review/

4 Finance, Insurance and Market

In the financial sector, EU legislation requires financial institutions to disclose a significant amount of data products, transactions and financial results. Moreover, the revised Payment Services Directive marks an important step towards open banking, where innovative payment services can be offered to consumers and businesses on the basis of the access to their bank account data. Going forward, enhancing data sharing would contribute to stimulating innovation as well as achieving other important policy objectives at EU level.

The Commission is working to further facilitate access to public disclosures of financial data or supervisory reporting data, currently mandated by law. This to facilitate more efficient processing of such publicly accessible data to the benefit of a number of other policies of public interest, improve market transparency and support sustainable finance in the EU.

The use of data science can lead to both new types of products in retail banking and insurance, improvements in risk management and to internal efficiency gains, leading to improved customer experience and decision making or even eliminating such decision-making. Benefits will be in particular for both consumers and SME customers. Examples are: improved risk scoring and more credit available, improved assessment of insurability of assets, in particular against cyber-attacks, customer profiling, fraud and anti-money laundering detection, document classification, on-boarding, human decision-making support, conversation interfaces, contextual recommendations, adaptive experiences, financial health assessments, life events support, but also novel consumer-facing services allowing the instant estimation of a mortgage for real estate based on an analysis of different (public) databases.

The rapid decline in computing costs, the emergence of the Internet as a communication tool, the rapid development of the mobile internet, the proliferation of day-to-day applications, and the increasing role of internet-based social networks and commercial platforms, have greatly affected the functioning of the economy and have profoundly affected businesses, public organisations, and personal life. Online retailers are a growing force in consumer retail markets. Their share of sales continues to grow, prompting economists to wonder about their impact on inflation. Much of the attention among central bankers and the press have been on whether the competition between online and traditional retailers is reducing retail mark-ups and putting downward pressure on prices.

4.1 Monitoring the business cycle with aspect-based sentiment extraction from news

Luca Barbaglia, Sergio Consoli, Sebastiano Manzan

Main AI Stream

Natural language processing.

Policy areas and legal reference

- Monetary Policy, Fiscal Policy, Forecasting of Economic Indicators

Objectives

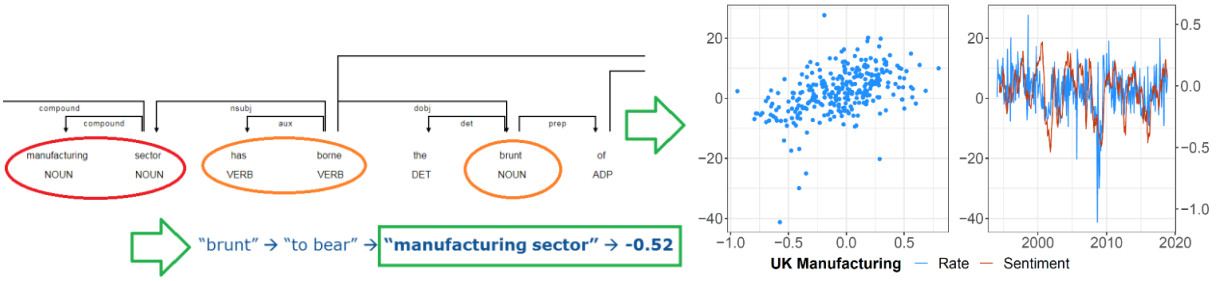
Extract relevant sentiment signals from news articles that can be useful for improving forecasting of economic indicators by: (i) considering long time periods; (ii) analysing the raw text of articles; (iii) using advanced Natural Language Processing (NLP) techniques.

Methodology

Develop and use a fine-grained, aspect-based sentiment analysis approach. Main characteristics:

- *Aspect-recognition:* Detect the entity to which the sentiment aspect is expressed;
- *Unsupervised:* Use of external lexical resources (dictionaries) for polarity scores;
- *Rule-based* approach based on the linguistic features of spaCy (Python);
- *World Bank Group Ontology* for deriving economic synonyms via SPARQL queries.

An example: *British manufacturing sector has borne the brunt of the global economic slowdown over the past few months and...*



Scientific references

- Dridi, A., Atzeni, M., Reforgiato Recupero, D. (2018) FineNews: *Fine-grained semantic sentiment analysis on financial microblogs and news*. Int J Mach Learn Cyb, 1–9
- Recupero, D.R., Presutti, V., Consoli, S., Gangemi, A., Nuzzolese, A.G. (2015) *Sentilo: Frame-based sentiment analysis*. Cognitive Computation 7, 211–225
- Shapiro, A.H., Sudhof, M., Wilson, D. (2018) *Measuring news sentiment*. Federal Reserve Bank of San Francisco Working Paper
- Tetlock, P.C. (2007) Giving content to investor sentiment: The role of media in the stock market. The Journal of Finance 62(3), 1139–1168

4.2 Loan Default Analysis in Europe: Tracking Regional Variations using Big Data

Luca Barbaglia, Sebastiano Manzan, Elisa Tosetti

Main AI Stream

Machine Learning.

Policy areas and legal reference

- Credit risk assessment; housing sector; macro-prudential policies.

Objectives

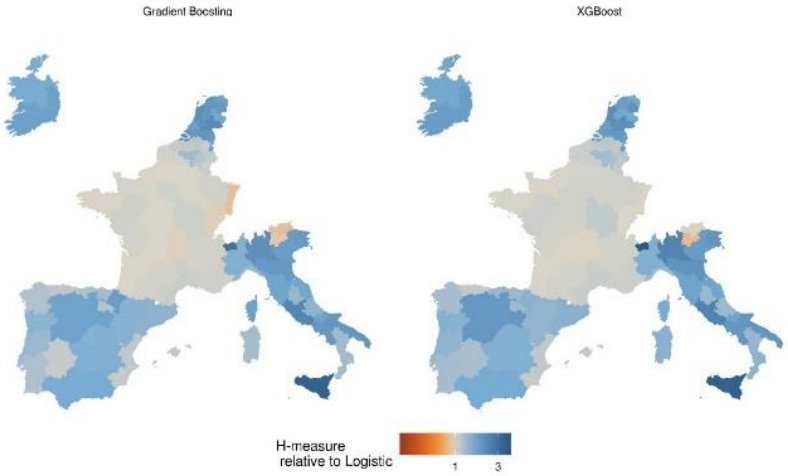
Apply machine learning methods on loan-level data about European mortgages to:

- Provide an accurate forecast of the default occurrence
- Identify the main drivers of default
- Highlight heterogeneity across European NUTS2 regions

Methodology

Provide a default forecast using loan-level data from the European Datawarehouse on 20 million mortgages in 96 European NUTS2 regions observed from 2013 to 2018.

- We compare the *forecasting performance* of penalized logistic regression, gradient boosting and eXtreme Gradient Boosting (XGBoost): non-linear boosting models perform statistically significantly better than the logistic linear benchmark.
- Assess the variable importance using *interpretable machine learning*: current loan-related features (e.g. interest rate and loan-to-value) are more important in predicting default than borrower or regional features.
- We highlight *regional heterogeneity* both across countries and within country: regional features are most important to forecast default in the areas where GDP grew largely before the 2008 financial crisis and fell sharply afterwards.



Scientific references

- Elul, R., Souleles, N. S., Chomsisengphet, S., Glennon, D. and Hunt, R. (2010), "What Triggers Mortgage Default?" *American Economic Review: Papers & Proceedings*, 100, 490-494.
- Fitzpatrick, T. and Mues, C. (2016), "An Empirical Comparison of Classification Algorithms for Mortgage Default Prediction: Evidence from a Distressed Mortgage Market" *European Journal of Operational Research*, 249, 427-439.

4.3 Time series forecasting by recommendation: an empirical analysis on Amazon Marketplace

Álvaro Gómez-Losada and Néstor Duch-Brown

Main AI Stream

Recommendations engine and collaborative filtering

Policy areas and legal reference

- Digital single market and consumer protection.
- Regulation (EU) 2019/1150 (*OJ L 186, 11.7.2019, p. 57–79*) on promoting fairness and transparency for business users of online intermediation services (Platform to Business -P2B- Regulation).
- Directive 2011/83/EU (OJ L 304, 22.11.2011, p. 64–88) on consumer rights.

Objectives

- To propose a forecasting methodology for univariate time series using a Recommender System.
- To evaluate the differences among the recommended prices and those set by Amazon for products in the Marketplace

Methodology

The Recommender System (RS) is built from a given univariate time series (TS) as only input data and following an item-based Collaborative Filtering approach. A set of top-*N* values is recommended for this TS which represent the forecasts. The idea is to emulate RS elements (the users, items and ratings triple) from the TS. Two TS obtained from Italy's Amazon webpage were used to evaluate this methodology and very promising performance results were obtained, even the difficult environment chosen to conduct forecasting (short length and unevenly spaced TS). This performance is dependent on the similarity measure used and suffers from the same problems that other RSs (e.g., cold-start). However, this approach does not require high computational power to perform and its intuitive conception allows for being deployed with any programming language.

Scientific references

- Gómez-Losada, A., Duch-Brown, N., 2019. Time Series Forecasting by Recommendation: An Empirical Analysis on Amazon Marketplace, in W. Abramowicz and R. Corchuelo (eds.), Business Information Systems. Seville, 26-28 June, 2019. Cham: Springer International Publishing, pp. 45-54. Available at: https://link.springer.com/chapter/10.1007/978-3-030-20485-3_4.

5 Agriculture

Data is one key element to enhance the sustainability performance and competitiveness of the agricultural sector. Processing and analysing production data, especially in combination with other data on the supply chain and other types of data, such as earth observation or meteorological data, allows for precise and tailored application of production approaches at farm level. Technologies, in particular the role-out of objects and devices connected to the Internet-of Things paired with advances in data analysis technologies and machine learning, have created new data supply chains that have the potential to redefine the role of farmers. More and more they will contribute to and benefit from new digital services and underlying business models. Precision agriculture can benefit immensely from digital solutions in pursuing the ambitious sustainability objectives of the European Green Deal.

A common data space for agricultural data based on existing approaches towards data sharing could lead to a neutral platform for sharing and pooling agricultural data, including both private and public data. This could support the emergence of an innovative data-driven ecosystem based on fair contractual relations as well as strengthen the capacities for monitoring and implementing common policies and reducing administrative burden for government and beneficiaries. In 2019, Member States have joined forces and signed a declaration of cooperation 'A smart and sustainable digital future for European agriculture and rural areas', which recognises the potential of digital technologies for the agricultural sector and rural areas and supports the setting up of data spaces. The vision is to enable the emergence of data ecosystems where value is created from contributing data and insights, e.g. by giving access to certain data or insights and in return benefitting from the added value creation enabled by data analytics and AI.

5.1 Applied machine learning in CAP Checks by Monitoring

Guido LEMOINE, Pavel MILENOV, Konstantinos ANASTASAKIS and Wim DEVOS (D.5)

Main AI Stream

Machine learning / Deep learning

Policy areas and legal reference

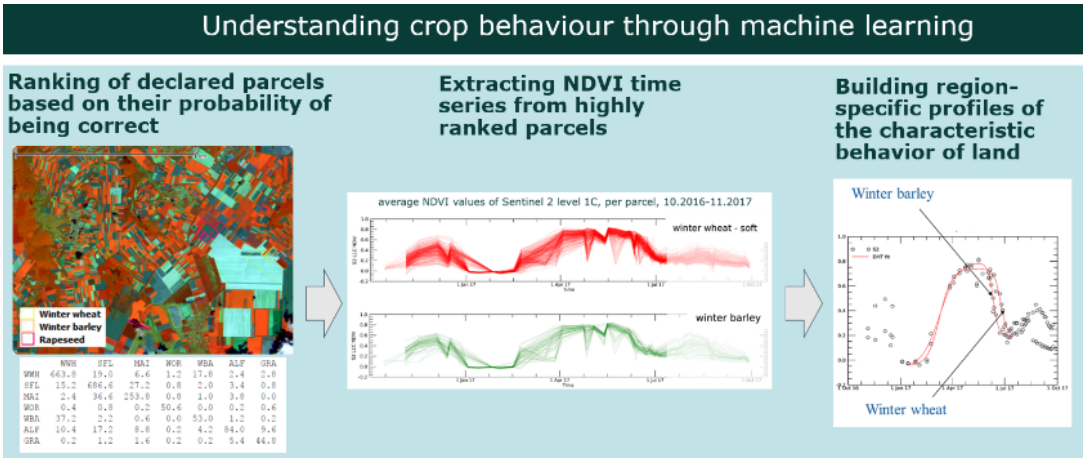
- Common Agricultural Policy
- Checks by Monitoring (CbM) - Reg. (EU) 2018/746
- Copernicus Sentinels satellites integrated with EGNOS/Galileo data
- Automated processing and analysis of farm applications
- Copernicus - Reg. (EU) 2014/377
- Sentinel data uptake and DIAS deployment in public use cases

Objectives

- To develop the methodological and technical framework for the implementation of monitoring approach for compliance checks under CAP and its gradual phasing-in
- CAP Checks by Monitoring replaces “on the spot checks”
- Based on 100% territory wide observation with Sentinels all year round
- And, therefore, Big Data Analytics, based on smart machine learning
- Implement and benchmark on Copernicus DIAS to support CbM on-boarding EU countries
- Shift the focus from penalty to prevention; use of intelligent warnings
- To upgrade the current compliance control into a system more suitable for the delivery of the climate and environmental priorities of the CAP 2020

Methodology

Use machine learning (with tensorflow) on Copernicus Application Ready Data, extracted for each parcel, to build knowledge on links between farming practice and land behaviour. Identify and analyse “outliers”. Copernicus DIAS cloud services give access to required Sentinel data.



Scientific references

- Devos W. et al., “Technical guidance on the decision to go for substitution of OTSC by monitoring”. Publications Office of the European Union, Ispra, 2018, ISBN 978-92-79-94173-3
- Lemoine G., Devos W., Milenov P., d'Andrimont R., Machine Learning for Crop Type Identification Using Country-Wide, Consistent Sentinel-1 Time Series, 2019 Conference on Big Data from Space (BiDS'19), 19-21 February 2019, ESA, SatCen, JRC, DLR, Munich, Germany

5.2 Exploratory Research project Rural Refocus

Marijn van der Velde, Laura Martinez Sanchez, Raphael d'Andrimont, Momchil Yordanov, Guido Lemoine

Main AI Stream

Computer vision / Image recognition.

Policy areas and legal reference

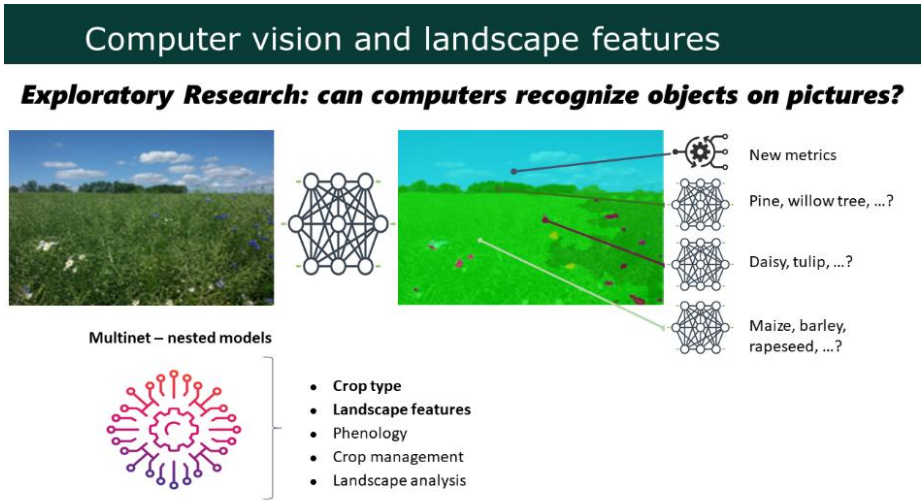
- Copernicus programme: strengthening the in-situ component by generating in-situ data from crowdsourced imagery
- Common Agricultural Policy 2020+ reform: new tools for providing evidence and monitoring of impacts respectively related to the evolution of the implementation framework and expanding the tool-kits underpinning the Strategic Plans of Member States

Objectives

- To explore the capacity of crowdsourced geotagged street-level imagery to provide relevant and timely information along the growing season on *crop type* and *phenology*
- To create a LUCAS photos based digital library of reference image datasets that can be used to train computer vision algorithms
- To develop computationally intensive machine learning algorithms to recognize and classify digital photographs according to crop type, phenology, and later landscape elements and farm activity.
- To provide a novel source of in-situ data whose derivation is *easily* applied to other sectors helping us to valorise the remotely sensed observations of the Copernicus Sentinels.

Methodology

To train deep learning algorithms on already labelled imagery obtained from LUCAS surveys to recognize crops and landscape elements and subsequently apply these algorithms on crowd-sourced imagery to derive precisely geo-located in-situ information. For details, please refer to the full proposal of the Exploratory Research project Rural Refocus started November 2019.



Scientific references

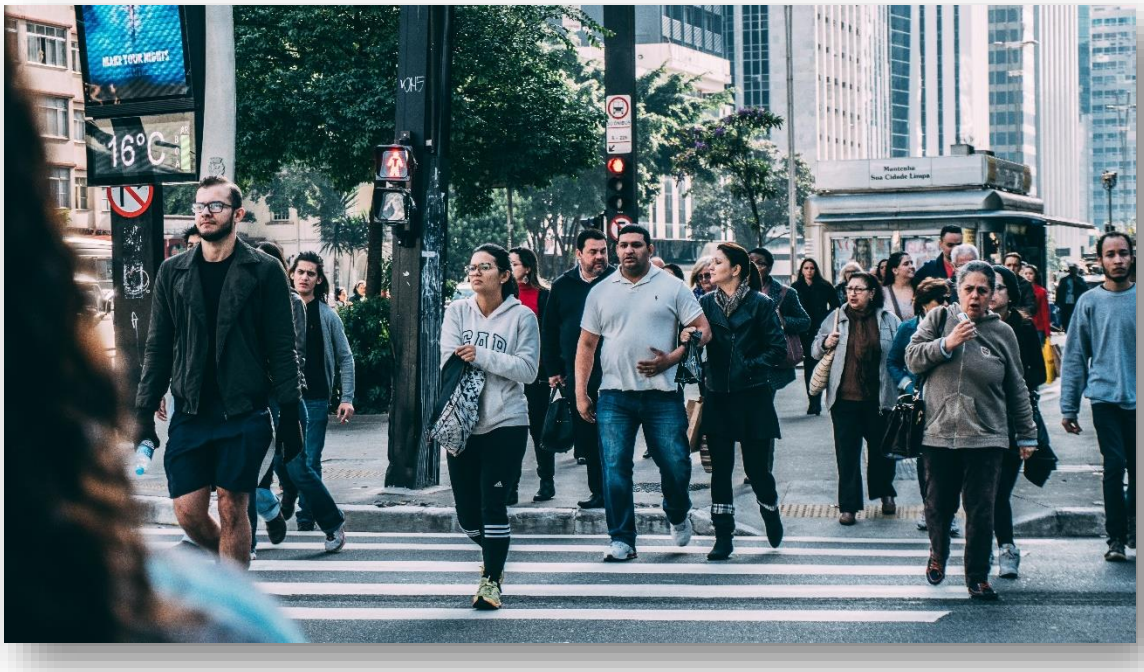
- D'Andrimont, R.; Yordanov, M.; Lemoine, G.; Yoong, J.; Nikel, K.; Van der Velde, M. Crowdsourced Street-Level Imagery as a Potential Source of In-Situ Data for Crop Monitoring. *Land* 2018, *7*, 127

6 Public Administrations

Europe has a long and successful history of technology and creativity. Europe is strongest when it acts together and joins forces between the EU and its Member States; involving regions and municipalities, academia, civil society, financial institutions, businesses and social enterprises. Promoting the digital transformation of public administrations throughout Europe is crucial in this regard.

Public administrations are big producers and also users of data in different areas. It is essential that public administrations, hospitals, utility and transport services, financial supervisors, and other areas of public interest rapidly begin to deploy products and services that rely on AI in their activities. This further digitalization of public administrations will improve transparency and accountability of public spending and spending quality, fighting corruption, both at EU and national level, and to address law enforcement needs and support the effective application of EU law and enable innovative 'gov tech', 'reg tech' and 'legal tech' applications supporting practitioners as well as other services of public interest.

All levels government are becoming more and more data driven as governments are adopting the roles of provider, user, broker and custodian of data. Ensuring access to data by public authorities means that everybody can benefit from its reuse. An important challenges deal with a legal framework to allow reuse of private and public sector data and policy guidelines to remove difficulties in aligning existing policies (e.g. on data reuse and GDPR). Connectivity and interoperability, including a cloud federation for public administrations (i.e. secured and scalable cloud computing infrastructures and cloud-based services) play a key role to help overcoming many difficulties and enhance the delivery of public services.



6.1 AI WATCH: Operational definition of Artificial Intelligence

Samoili, S., López Cobo, M., Gómez, E., De Prato, G., Martínez-Plumed, F., and Delipetrev, B.

Main AI Stream

Conceptualisation of artificial intelligence, Natural language processing

Policy areas and legal reference

- AI Watch, the European Commission knowledge service to monitor the development, uptake and impact of Artificial Intelligence (AI) for Europe. Legal references:
- Communication "Artificial Intelligence for Europe" COM(2018)237.
- Communication “Coordinated Plan on Artificial Intelligence”, COM(2018)795.

Objectives

To propose an operational definition of AI to be adopted in the context of AI Watch, constituted by a taxonomy and a list of keywords that characterise the core domains of the AI research field, and transversal topics such as applications of the former or ethical and philosophical considerations.

Methodology

A mixed flexible methodology that allows regular revision, following three steps:

1. Qualitative analysis on 55 documents including AI definitions from three complementary perspectives: policy, research and industry. This analysis leads us to identify four characteristics that are commonly mentioned and constitute the core of our definition.
2. Propose a set of AI domains and sub-domains, derived from multiple sources.
3. For each of the defined sub-domains, we create a representative list of keywords, as the result of a multi-step process combining a semi-automatic text mining approach, desk research and domain experts' involvement.

	AI taxonomy	
	AI domain	**AI subdomain**
Core	**Reasoning**	Knowledge representation
		Automated reasoning
		Common sense reasoning
	Planning	Planning and Scheduling
		Searching
		Optimisation
	Learning	Machine learning
	Communication	Natural language processing
	Perception	Computer vision
		Audio processing
Transversal	**Integration and Interaction**	Multi-agent systems
		Robotics and Automation
		Connected and Automated vehicles
	Services	AI Services
	Ethics and Philosophy	AI Ethics
		Philosophy of AI

Scientific references

- Samoili, S., López Cobo, M., Gómez, E., De Prato, G., Martínez-Plumed, F., and Delipetrev, B., AI Watch. Defining Artificial Intelligence. Towards an operational definition and taxonomy of artificial intelligence, EUR 30117 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-17045-7, doi:10.2760/382730, JRC118163.

6.2 Detecting Sentiment Trends in Multilingual Texts

Alexandra Balahur and TMA-CC Team

Main AI Stream

Natural Language Processing, Machine Learning

Policy areas and legal reference

- "Support for innovative policy-making" [2019-2020 JRC WP]
- support innovation in EU policy-making - develop generic tools and processes, taking into account anticipation, behavioural insights, design for policy, citizens' engagement, media monitoring, data and text-mining, including support to the detection and handling of disinformation ("fake news").

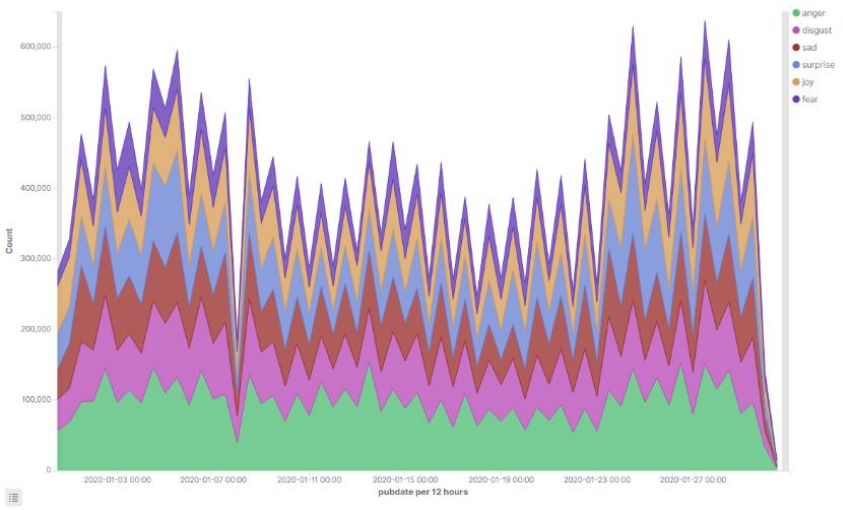
Objectives

To build a multilingual text analysis system that is able to automatically classify news articles and social media items written in different languages according to the sentiment they express – positive, negative or neutral and according to the emotion they contain, according to the Ekman list of emotions: joy, anger, fear, sadness, surprise or disgust. Further on, we aimed at classifying sentiment in context – i.e. in dependence of the topic the sentiment or emotion is attached to.

Methodology

Use of machine translation and supervised ML as the basis for one of the in-house multilingual sentiment analysis system for news and social media. To tackle the challenge of topic-dependence, we employed the categories present in the Europe Media Monitor system.

The initial model was trained on English; subsequently, the training data were translated using different machine translation systems in Spanish, French and German. The same supervised ML algorithm was applied to the resulting datasets, using different features and feature representations. The choice of features and feature representation resulted crucial in the process of building a robust model. Subsequent experiments included more languages and new types of text, such as tweets. The system has been successfully employed to follow trends of sentiment and emotion on different policy areas.



Scientific references

- Pavel Priban and Alexandra Balahur. 2019. Comparative Analyses of Multilingual Sentiment Analysis Systems for News and Social Media. Lecture Notes in Computer Science (Springer) – in print.
- Alexandra Balahur and José M. Perea-Ortega. 2015. Sentiment analysis system adaptation for multilingual processing. Inf. Process. Manage. 51, 4 (July 2015), 547-556. DOI=10.1016/j.ipm.2014.10.004 http://dx.doi.org/10.1016/j.ipm.2014.10.004
- Alexandra Balahur and Marco Turchi. 2014. Comparative experiments using supervised learning and machine translation for multilingual sentiment analysis. Comput. Speech Lang. 28, 1 (January 2014), 56-75. DOI: http://dx.doi.org/10.1016/j.csl.2013.03.004

6.3 Semantic Text Analyser (SeTA)

Jiri Hradec, Lucia Noce

Main AI Stream

Semantic Text Analyzer (SeTA) is a direct application of Natural Language Processing and Machine Learning into the EC context. SeTA has been harvesting the complete stream of the public European Commission's documents, reports, projects and legislation, training a set of neural networks for representation learning and uses machine learning to analyze the resulting vector space.

Policy areas and legal reference

Key users of SeTA are the policy analysts who need powerful semantic search, steep learning curve of new domains and policy context awareness. Rich API positions SeTA in the center of many knowledge extraction and management tools of the Commission. New users are recruiting from many other domains as well, be it for scope difinition, comonalities extraction or simply quick search over the complete document corpus.

Objectives

The main objectives:

- Making the European documents accessible for people and machines with a strong accent on content discovery
- Semantic analysis used as a leverage in extraction of implicit knowledge as learned by the neural networks
- Fact checker on paragraph/sentence level to allow verification of text against existing databases (e.g. ESTAT, OECD), extraction of previous mentions. Massive use of named entity extraction and coreference resolution.

Methodology

As described in our technical report, the SeTA has been based on complex data collection and cleaning pipeline to create a database storing text alongside its metadata. Several neural networks have been utilised in every step of the corpus creation, analysis and publication. Deep neural networks based on attention mechanism are used for NER extraction and POS tagging, Word2Vec/FastText for representation learning etc.

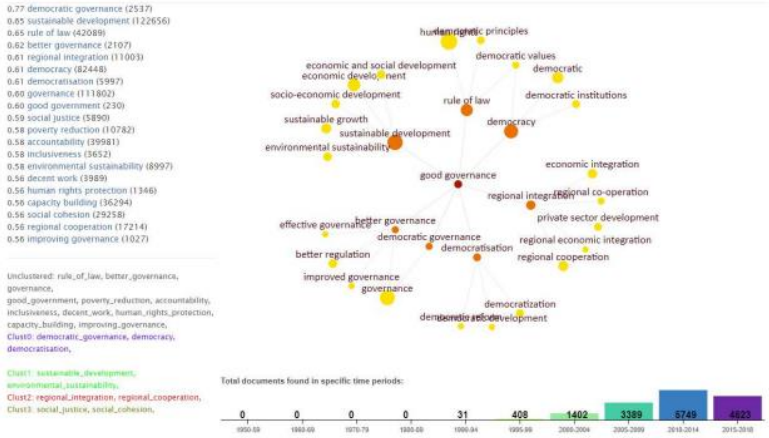


Figure. The context of the term good governance

Scientific references

- Hradec, J., et al., 2019. Semantic Text Analysis tool (SeTA), https://ec.europa.eu/jrc/en/publication/semantic-text-analysis-tool-seta

6.4 Thematic areas of strength in the AI Worldwide Ecosystem

Samoili S., Righi R., Cardona M., López Cobo M., Vázquez-Prada Baillet M., and De Prato G.

Main AI Stream

Natural language processing

Policy areas and legal reference

- AI Watch, the European Commission knowledge service to monitor the development, uptake and impact of Artificial Intelligence (AI) for Europe. Legal references: "Artificial Intelligence for Europe", COM(2018)237; "Coordinated Plan on Artificial Intelligence", COM(2018)795.

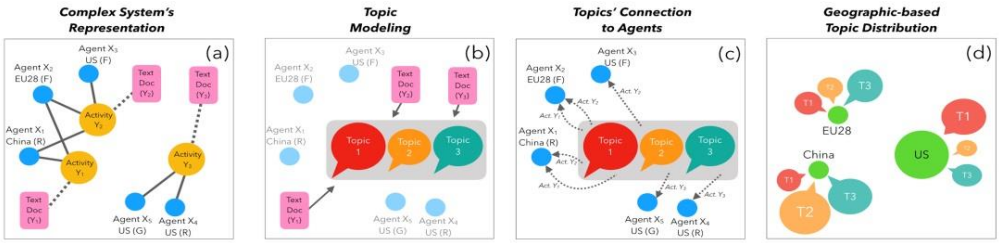
Objectives

- To detect AI-related thematic subdomains and domains of industrial and R&D activities.
- To assess countries' and regions' specializations and performance.

Methodology

- **From collected documents to terms:** After a text-mining process to identify the AI-related R&D and industrial activities worldwide, we extract relevant technological terms. The keyword extraction is conducted with a pre-trained language agnostic model. This output has better semantic relatedness than the TF-IDF index and provides an improved input for topic modelling.
- **From terms to topics and technological subdomains:** To identify the technology's subdomains in the absence of a standard classification for AI, we use the Latent Dirichlet Allocation (LDA) topic model. LDA discovers latent semantic patterns (topics) and clusters the collected text without predetermined classes. The model returns the topics more likely to describe each document, which better represent the corpus. From the corpus's topics we detect the AI subdomains.
- **From topics to geographical specialisation:** By connecting the documents' subdomains to the agents' information, we quantify the countries' and regions' specialisations in each subdomain, as illustrated in the figure. Economic agents in the same knowledge subdomain mutually use a set of technical terms (a). The topics are extracted from the textual information of the activities through topic modelling (b). In (c), the activities are connected again to the agents carrying the thematic information. In (d), the thematic profile and performance of each geo entity can be analysed.

The advancement of our implementation of topic modelling consists of identifying emerging technological subdomains with the titles, abstracts, and keywords (when available) of both R&D and industrial economic activities.



Scientific references

- Samoili S., Righi R., Cardona M., López Cobo M., Vázquez-Prada Baillet M., and De Prato G., TES analysis of AI Worldwide Ecosystem in 2009-2018, EUR 30109 EN, Publications Office of the European Union, Luxembourg, 2020.
- Samoili S., Righi R., Lopez-Cobo M., Cardona M., De Prato G. (2019) Unveiling Latent Relations in the Photonics Techno-Economic Complex System. In: Cagnoni S., Mordonini M., Pecori R., Roli A., Villani M. (eds) Artificial Life and Evolutionary Computation. WIVACE 2018. Communications in Computer and Information Science, vol 900. Springer, Cham.

7 Security and Safety

In the area of cybersecurity Europe has developed an already comprehensive framework to support MS, businesses and citizens to tackle cybersecurity threats and attacks, and Europe will continue to develop and improve its mechanisms to protect its data and the services building on it.

A true digital transformation has to start from European citizens and businesses trusting that their applications and products are secure. The more interconnected we are, the more we are vulnerable to malicious cyber activity. Feeling safe and secure is not just a question of cybersecurity. Citizens need to be able to trust the technology itself, as well as the way in which it is used. This is particularly important when it comes to the issue of artificial intelligence.

The use of AI in products and services can give rise to risks that EU legislation currently does not explicitly address. These risks may be linked to cyber threats, personal security risks (linked for example to new applications of AI such as to home appliances), risks that result from loss of connectivity, etc. These risks may be present at the time of placing products on the market or arise as a result of software updates or self-learning when the product is being used. Modelling, simulation and response capabilities must be studied to enhance the security and resilience of physical infrastructures and prevent or respond to cybercrime. Cybersecurity issues may also deal with service providers that, operating in the EU, are subject to legislation of third countries, which can be in contradiction with the EU data protection framework.

While AI can help protect citizens' security and enable them to enjoy their fundamental rights, citizens also worry that AI can have unintended effects or even be used for malicious purposes. These concerns need to be addressed.

7.1 Algorithms for decision making in criminal justice

Songül Tolan, Marius Miron, Emilia Gómez

Main AI Stream

Machine Learning.

Policy areas and legal reference

- Ethical/Fair AI.
- AI for high stakes decision making.

Objectives

- This is about causes of discrimination and the potential sources of biases that may occur in decision making. We evaluate human and algorithmic decisions by exploring the trade-off between predictive performance and group-fairness metrics. Towards identifying the sources of discrimination, we design evaluation experiments to isolate the influence of data and of different parts of a machine learning pipeline. In addition, we use machine learning interpretability to identify important features for black-box models.
- Our main case study is assessing re-offense risk of defendants in Catalonia where human and machine evaluation are based on information from a structured professional judgement. The framework used in our experiments is open source and can be applied in similar contexts where data is available

Methodology

Multilayer perceptron, Logit

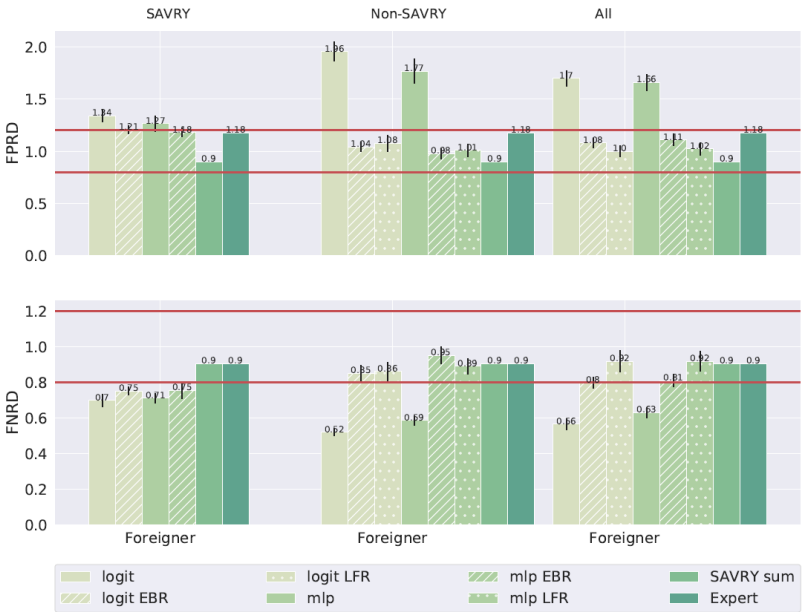


Figure shows comparison of group fairness metrics "False-positive rate disparity" (FPRD) and "False-negative rate disparity" in terms of foreigner status. The reference group is "Spanish nationals". Classifications outside the red band are considered "unfair". We compare ML methods (logit, MLP) with a clinical assessment by experts (SAVRY sum, Expert). We apply unfairness mitigation techniques "Equalized Base Rates" (EBR) and "Learning Fair Representations" (LFR). The figure shows that the clinical expert assessment is always fair, while unrestricted ML methods are always unfair. Mitigation techniques tend to make ML classifications look fairer.

Scientific references

- Tolan, S., Miron, M., Gómez, E., & Castillo, C. (2019, June). Why machine learning may lead to unfairness: Evidence from risk assessment for juvenile justice in catalonia. In Proceedings of the Seventeenth International Conference on Artificial Intelligence and Law (pp. 83-92).
- HUMAINT JRC CAS Gitlab, available at: https://gitlab.com/HUMAINT

7.2 How can AI be fooled? Exploring AI robustness and explainability in light of cybersecurity and data protection

Henrik Junklewitz, Ronon Hamon, Ignacio Sanchez, Igor Nai-Fovino

Main AI Stream

Deep Learning/Machine Learning; Computer Vision; Natural Language Processing.

Policy areas and legal reference

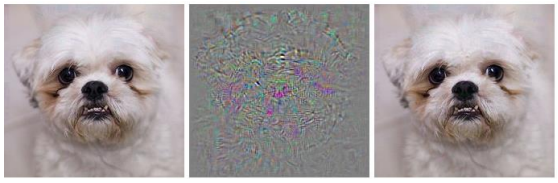
- EU AI and cybersecurity policy and regulation:
  - Communication on Artificial Intelligence for Europe (25 April 2018)
  - Coordinated Plan on Artificial Intelligence (7 December 2018)
  - High Level Expert Group's Ethics Guidelines for Trustworthy AI (18 December 2018)
  - EU Commission White Paper on AI (19 February 2020)

Objectives

- Exploring the robustness of AI systems against malicious action, misuse and wrong handling together with the consequences of a lack of explainability and interpretability of AI in the context of the many new policy developments in this area.

Methodology

Robustness of AI systems



Classified as: dog. Add crafted noise. Classified as: ostrich.

Left: real graffiti on STOP sign.
Right: designed stickers to mimic the situation and fool an object recognition AI. 82% successful attack rate.

Explainability of AI systems

The right to explanation

- Understand and measure the robustness of machine learning architectures
- Compare to classical software vulnerabilities

- Interplay of AI explainability and legal requirements
- Connections between lack of AI robustness and explainability

Scientific references

- Artificial Intelligence: A European Perspective, JRC report 2018; and references therein
- Robustness and Explainability of Artificial Intelligence, JRC technical report 2020

7.3 Clustering and Unsupervised Learning for Digital Forensics – An Update: Unsupervised Video Forensics

Henrik Junklewitz, Pasquale Ferrara, Laurent Beslay

Main AI Stream

Deep Learning/Machine Learning, Natural Language Processing, Computer Vision

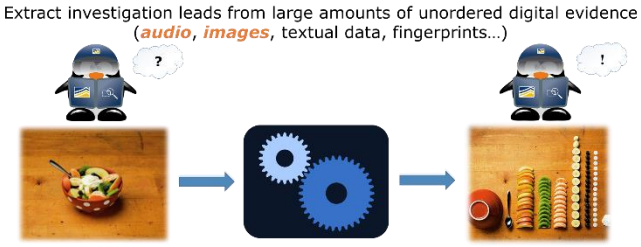
Policy areas and legal reference

- EU cybersecurity policy. Main legal references:
  - JOIN(2013) 1 final, EU cybersecurity strategy
  - COM(2015)185 final The European Agenda on Security
  - 11th Security Union Progress Report (SUPR), 18 October 2017

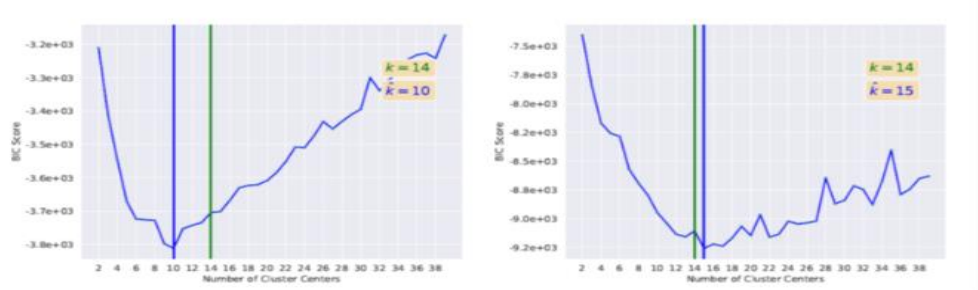
Objectives

- Using machine learning & deep learning methods for enhancing the efficiency of forensic evidence making & crime investigation; give general support to European law enforcement agencies

Methodology



- Forensic case: analyse video material in the context of child abuse online cases.
- Cluster identified pictures to source camera/microphone devices as in bullet ballistics.
- Focus on 2 problems:
- How to deal with a number of source devices a priori unknown?
- Methods: Mixture model clustering with a statistical model selection procedure.
- Tackle high dimensionality of data.
- Methods: Sparse sampling and Autoencoder dimensionality reduction



Scientific references

- JRC Camera fingerprinting based on Sensor Pattern Noise as a tool for combatting Child Abuse on-line – 2014 – JRC 93821

7.4 Dynamic Global Conflict Risk Index

Matina Halkia, Stefano Ferri, Michail Papazoglou, Marie-Sophie Van Damme, Gabriel Jenkinson, Kathrin Baumann and Dimitrios Thomakos

Main AI Stream

Deep learning/machine learning; Natural language processing

Policy areas and legal reference

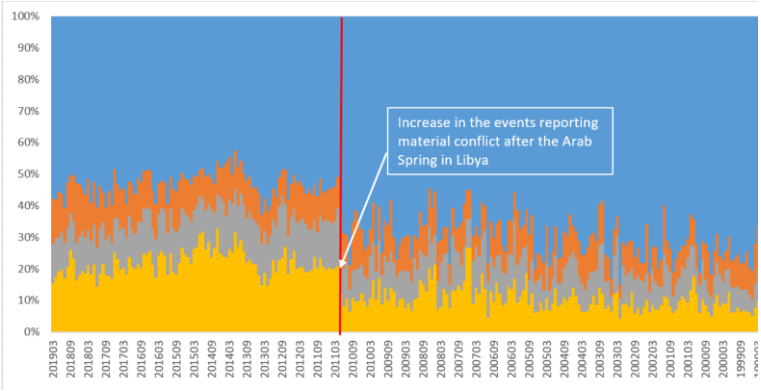
- Conflict prevention, peace and security:
- EU priorities at the United Nations and the 74th United Nations General Assembly (September 2019 – September 2020)

Objectives

The new AI event-based conflict risk model supports the design of European Union's (EU) conflict prevention strategies using country-level actor-based event data sets that signal potential triggers to violent conflict such as demonstrations, strikes, or elections-related violence. The model aims at estimating the occurrence of material conflict events, and to identify every stage of the conflict development or de-escalation.

Methodology

The Artificial Intelligence (AI) methodology adopted to model the dynamic GCRI is built upon a Long-Short Term Memory (LSTM) Cell Recurrent Neural Network (RNN). These models are well-suited to classify, process and make predictions based on time series data and forecast near future events. Besides this AI model, we have set up an early warning alarm system to signal abnormal social unrest upheavals.



Scientific references

- Qiao, Fengcai, Pei Li, Xin Zhang, Zhaoyun Ding, Jiajun Cheng & Hui Wang (2017) Predicting Social Unrest Events with Hidden Markov Models Using GDELT. Discrete Dynamics in Nature and Society (https://doi.org/10.1155/2017/8180272).
- Sak, Hasim, Andrew Senior & Francoise Beaufays (2014) Long Short-Term Memory Recurrent Neural Network Architectures for Large Scale Acoustic Modeling.
- Schrodt, Philip A (2012) CAMEO Event (http://eventdata.psu.edu/).
- Schrodt, Philip A & David Van Brackle (2013) Automated Coding of Political Event Data. In: Handbook of Computational Approaches to Counterterrorism. New York, NY: Springer New York, 23–49 (http://link.springer.com/10.1007/978-1-4614-5311-6_2).
- Smith, Emmanuel M, Jim Smith, Phil Legg & Simon Francis (2018) Predicting the Occurrence of World News Events Using Recurrent Neural Networks and Auto-Regressive Moving Average Models. Advances in Intelligent Systems and Computing 650(MI): 191–202.
- Ward, Michael D, Andreas Beger, Josh Cutler, Matthew Dickenson, Cassy Dorff & Ben Radford (2013) Comparing GDELT and ICEWS Event Data. Analysis Vol. 21 (http://mdwardlab.com/biblio/comparing-gdelt-and-icews-event-data).

7.5 Robust Indoor Localization in Complex Scenarios (RISE)

Carlos Sanchez Belenguer, Erik Wolfart, Vitor Sequeira

Main AI Stream

Deep learning/Machine learning, Computer vision/Image recognition

Policy areas and legal reference

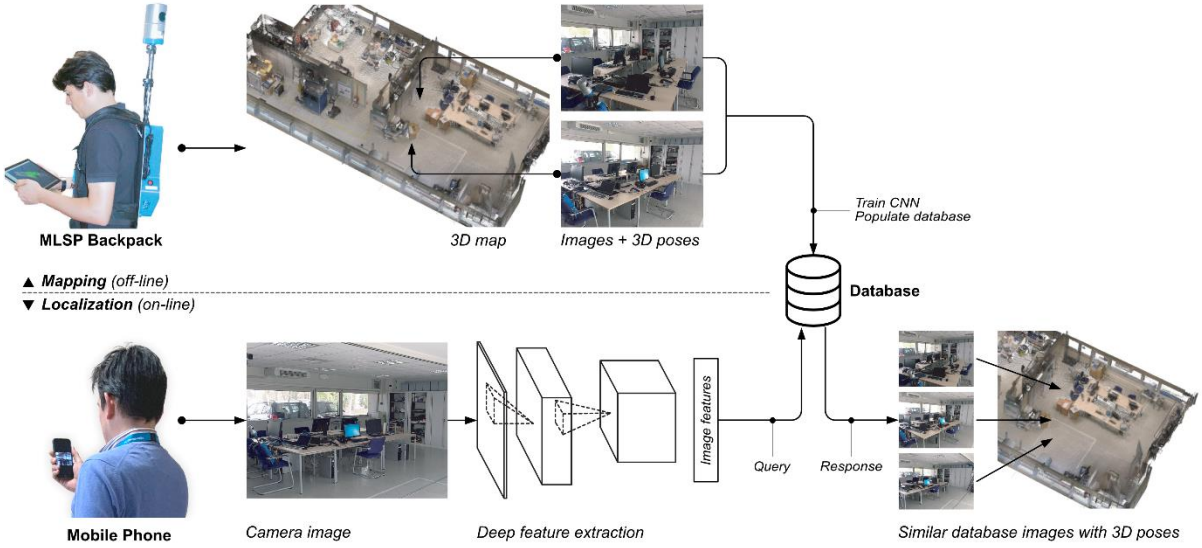
- Nuclear safeguards: Council Regulation (Euratom) N0 1314/2013 on the Research and Training Programme of the European Atomic Energy Community (2014-2018);
- Support the IAEA through the European Commission Cooperative Support Programme (EC-SP).

Objectives

- To contribute to research and development in the area of indoor localisation in infrastructure-free environments.
- To explore recent achievements made in machine learning for indoor localisation and provide reference data sets that can be used by other organisation

Methodology

To develop an indoor localization system using sensor data from mobile consumer devices. It uses NUVER's laser-based mapping backpack and applies Machine learning techniques for place recognition. The outcome is a comprehensive, multi-temporal reference dataset for indoor localization.



Scientific references

- Sanchez, Wolfart, Sequeira: RISE: A Novel Indoor Place Recognizer. Accepted In: ICRA 2020, France
- Sanchez, Wolfart, Sequeira: Global Matching of Point Clouds for Scan Registration and Loop Detection. In: Robotics and Autonomous Systems, Volume 123, January 2020
- Sanchez, Ceriani, Taddei, Wolfart, Sequeira: Global registration of point clouds for mapping. In: IAS-15 (2018)
- Ceriani, Sanchez, Taddei, Wolfart, Sequeira: Pose interpolation slam for large maps using moving 3d sensors. In: IROS (2015).
- Robust Indoor Localization in Complex Scenarios (RISE) (JRC Exploratory Research-Activity Tier).

8 Skills and Ethics

Europe strongest asset is represented by the skills of its people. In a global race for talent, the European education and training systems and labour markets need to quickly adapt to new and emerging skills needs. Improving education and skills is a key part of the overall vision for digital transformation in Europe. European companies need digitally savvy employees to thrive in the global technology-driven marketplace. In turn, workers need digital competences to succeed in an increasingly digitalised and fast changing labour market.

The European approach to AI will need to be underpinned by a strong focus on skills to fill competence shortages. The Commission is asked to ensure that everyone in Europe can benefit from the green and digital transformations of the EU economy. More women can and must have rewarding careers in tech, and European tech needs to benefit from women's skills and competences.

Currently, big data and analytics are top of the list of critical skills shortages. General data literacy in the workforce and across the population is relatively low and participation gaps exist (for example by elderly people). If it is not addressed, the shortage in data experts and the lack of data literacy will affect the EU capacity to master the challenges of the data economy and society. EU is called to reduce the skills mismatches between the education and training system on the one hand and the labour market needs on the other.

As with any new technology, the use of AI brings both opportunities and risks. Citizens fear being left powerless in defending their rights and safety when facing the information asymmetries of algorithmic decision-making, and companies are concerned by legal uncertainty. Over the last few years, thanks to an increase in data availability and computing power, AI techniques have been applied to different research problems related to computer vision, natural language processing, music processing or bioinformatics. Some of these techniques are said to surpass human-level performance (e.g. image recognition) and model highly abstract human concepts such as emotion or culture. The practical exploitation of AI algorithms brings up a discussion on the impact of these algorithms into the ways human behave.

Individuals should be further supported in enforcing their rights with regard to the use of the data they generate. They can be empowered to be in control of their data through tools and means to decide at a granular level about what is done with their data ('personal data spaces').

8.1 AI for music listening and creativity

Emilia Gómez, Marius Miron, Maria Iglesias

Main AI Stream

Recommendations engine and collaborative filtering, Machine Learning, Music Information Retrieval

Policy areas and legal reference

- Digital Transformation; Artificial Intelligence;
- Social, Cultural, Legal and ethical impact of AI, Cultural heritage, Copyright law.

Objectives

In this scenario, we study how the use of AI a creative context, music, can influence human artistic practice, taste and culture. The application of AI to music has been already studied in the literature for many decades, and presents numerous unique opportunities for a variety of uses, such as the recommendation of recorded music from massive commercial archives or the (semi-)automated creation of music. In these contexts, AI can produce outcomes in a domain fully entrenched in human creativity. In Sturm et al., (2019) we address two perspectives of AI applied to music creation: copyright law and engineering practice, and collects a set of questions which need to be answered such as how authorship and copyright is reconsidered in AI-generated music or how to ensure fairness and transparency in the use of AI in music. In Porcaro et al., (2019), we present a methodology to assess the impact of music recommendation diversity, or the lack thereof, on music listening experiences. In our work we intend to better understand how AI is changing and can change our opinion about music and our relationship with music for better and for worse.

Methodology

Machine Learning, Engineering, Law, Creative Practice

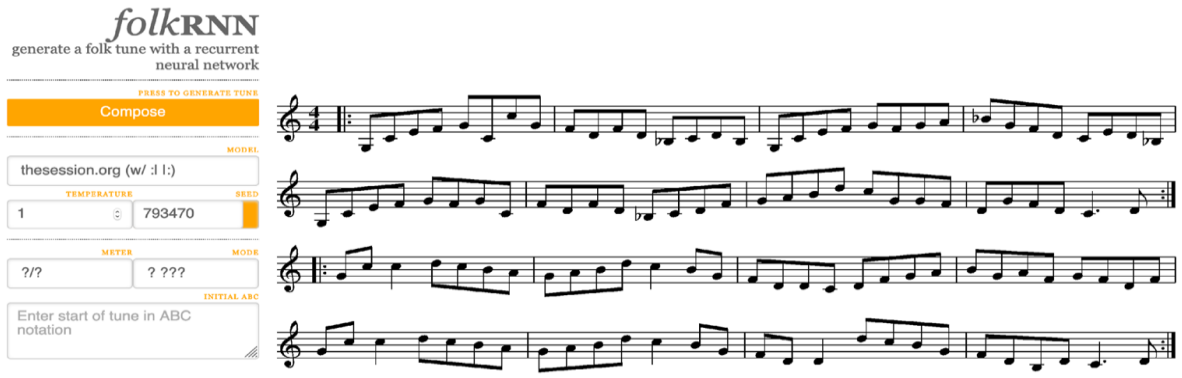


Figure. Screenshot of the FolkRNN system described at (Sturm et al. 2019)

Scientific references

- Sturm, B. L., Iglesias, M., Ben-Tal, O., Miron, M., & Gómez, E. (2019, September). Artificial intelligence and music: open questions of copyright law and engineering praxis. In Arts (Vol. 8, No. 3, p. 115). Multidisciplinary Digital Publishing Institute.
- Porcaro, L., Castillo, C., & Gómez, E. (2019). Music recommendation diversity: a tentative framework and preliminary results. In Miron M, editor. Proceedings of the 1st Workshop on Designing Human-Centric Music Information Research Systems, ISMIR, Delft, 2019.
- Lorenzo Porcaro, Emilia Gómez. (2019) 20 Years of Playlists: A Statistical Analysis on Popularity and Diversity. 20th Conference of the International Society for Music Information Retrieval (ISMIR 2019). Delft, 2019.

8.2 Social robots and human development

Vicky Charisi, Emilia Gómez

Main AI Stream

Social robotics

Policy areas and legal reference

- The role of social robots on child education, development, human rights, robotics

Objectives

There is a large amount of Human-Robot Interaction studies that examine the impact of social robots (embodied and social AI) in various everyday settings ranged from industrial cobots to home-based social agents.

In our project, we aim to contribute to the scientific understanding of the impact of social robots on human cognitive development by examining the effect of the type of robot intervention on children's problem-solving skills [1]. In addition to this, we examine the development of human trust by manipulating the robot's accuracy and social behaviour [2]. Lastly, we examine the possible cross-cultural differences regarding the occurrence of low-level non-verbal social features in order to contribute to the development of culturally sensitive robotic agents [3]. Towards this direction, we use various robotic platforms to conduct real-life user studies with adults and children by designing specific robot behaviours and interaction scenarios. Based on this research as well as on the current state of the art of the field of Child-Robot Interaction [4[, we contribute to the discussion on the emerging ethical challenges related to the use of social robots with children [5].

Methodology

Controlled behavioural experiments, design methods, child development evaluation

Figure. Child-robot collaborative problem solving

Figure. A routine generator application is used to combine the different actuators of the robot (motion of 5 degrees of freedom) to define the open-loop behaviours.

Scientific references

1. Charisi, V., Gómez, E., Mier, G., Merino, L., & Gomez, R. (2020). Child-Robot Collaborative Problem-Solving and the Importance of Child's Voluntary Interaction: A Developmental Perspective. Frontiers in Robotics and AI, 7, 15.
2. Charisi, V., Sabanovic, S., Thill, S., Gomez, E., Nakamura, K., & Gomez, R. (2019, March). Expressivity for sustained human-robot interaction. In 2019 14th ACM/IEEE International Conference on Human-Robot Interaction (HRI) (pp. 675-676). IEEE.
3. Charisi, V., Jokinen, K. (2019). Expressive multimodal communication for human-robot interactions in cross-cultural settings. In ACM/IEEE International Conference of Human-Robot Interaction.
4. Charisi, V., Alcorn, A. M., Kennedy, J., Johal, W., Baxter, P., & Kynigos, C. (2018, June). The near future of children's robotics. In Proceedings of the 17th ACM Conference on Interaction Design and Children (pp. 720-727).
5. AI and child rights policy, workshop report, UNICEF, New York, 2019 https://ai4children.splashthat.com

9 JRC AI&BD Community of Practice

In December 2018, JRC established a Community of Practice (CoP) on Artificial Intelligence and Big Data (AI&BD) –see https://webgate.ec.europa.eu/connected/groups/community-of-practice-ai-and-big-data

The mission of this CoP is to establish an operative information exchange platform with the overall aim of strengthening Artificial Intelligence and Big Data knowledge. In relation to these fields, specific objectives of this CoP are:

i) to foster knowledge sharing,

ii) to provide a friendly environment for sharing experiences,

iii) to reduce learning curves,

iv) to implement a network for staying up-to-date, and

v) to strengthen a professional identity.

AI&BD CoP convenes an annual workshop open to collect and present the ongoing JRC activities in the AI&BD field –i.e. the AI&JRC workshop. The CoP manage regular surveys of JRC competencies in the AI&BD domain.

Recently, the AI&BD CoP expressed the interest in contributing to relevant JRC initiatives, such as AI Watch.

9.1 JRC AI&BD Community of Practice: moving on

Stefano Nativi

Policy areas and legal reference

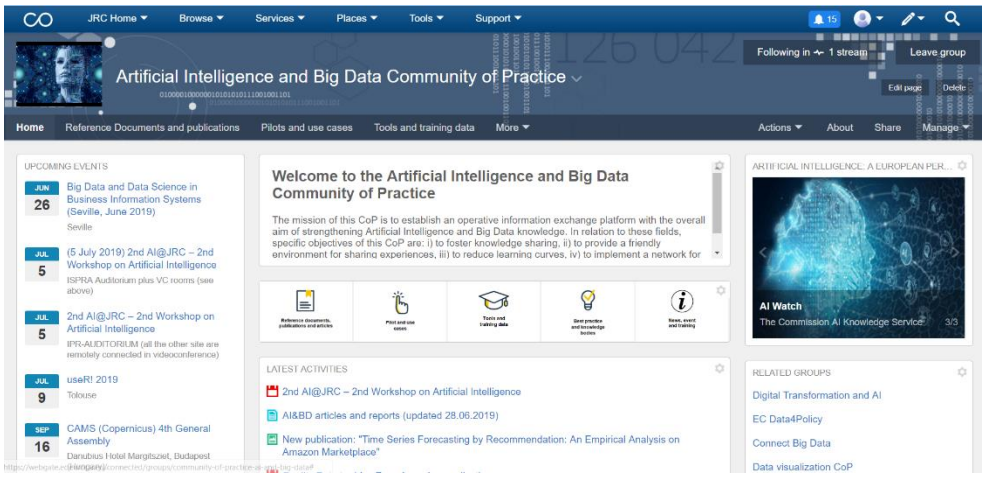
- The role of social robots on child education, development, human rights, robotics
  - European Commission, 2020, "White paper on Artificial Intelligence - A European approach to excellence and trust". COM(2020) 65 final.
  - "Artificial Intelligence for Europe", COM(2018)237; "Coordinated Plan on Artificial Intelligence", COM(2018)795.
  - 2019-2020 JRC WP - C(2019) 1872 final.

Methodology

After six months of fully operation, the AI&BD Community of practice counted about 90 members and published more than 150 content items. In the six months of operational use of the CoP, every day, the average number of active members was 40. As showed in the figure below, the CoP website is structured according to the following sections:

- Reference Document, Publications and Articles;
- Pilots and Use Cases;
- Tools and Training Data;
- Best Practices and Knowledge Bodies;
- News, Events and Training

.



At the 2nd AI@JRC Workshop, the CoP recognized the need to move forwards and make the community role further effective in supporting the JRC and the COM needs and activities. It was launched a poll asking the CoP members to select one of three possible evolution scenarios:

1. CoP as a platform devoted to inform, outreach and discuss –*Informative role with a very limited commitment.*
2. CoP as a network of experts that can contribute to AI Watch and similar initiatives –*More than an informative role characterized by a light commitment to devote some effort in providing scientific expertise/advising.*
3. CoP as a set of Task Forces/Working Groups committed to develop background documents and white papers –*A significant commitment to deliver quality document in time*.

Poll result clearly indicated that the members are available and interested in moving the CoP to be a network of experts that can contribute to AI Watch and similar initiatives.

Scientific references

- S. Nativi (Ed.) 2019. Artificial Intelligence at the JRC. Publications Office of the European Union. ISBN: 978-92-76-08842-4 (online). JRC117232.
- M. Craglia (Ed.) 2018. Artificial Intelligence: A European Perspective. Publications Office of the European Union. ISBN: 978-92-79-97217-1 (online). JRC113826.

9.2 AI@JRC Survey Report

Stefano Nativi

Policy areas and legal reference

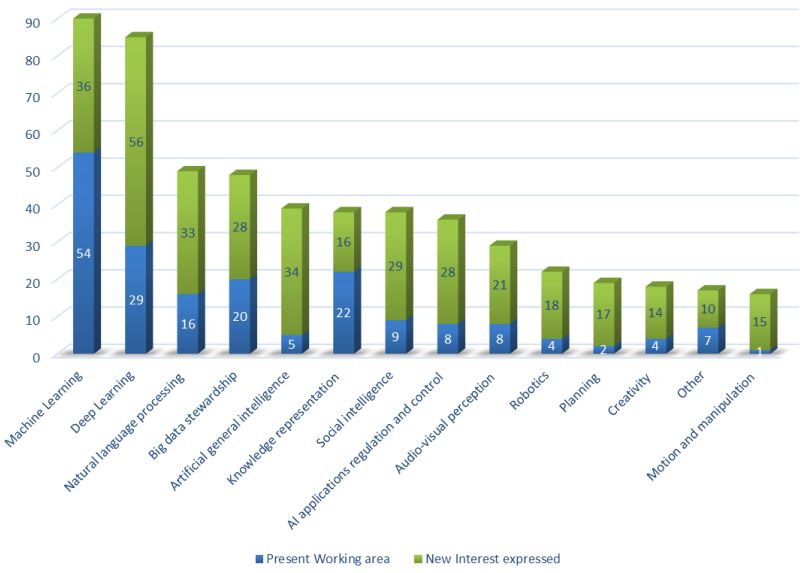
- The role of social robots on child education, development, human rights, robotics
  - European Commission, 2020, "White paper on Artificial Intelligence - A European approach to excellence and trust". COM(2020) 65 final.
  - "Artificial Intelligence for Europe", COM(2018)237; "Coordinated Plan on Artificial Intelligence", COM(2018)795.
  - 2019-2020 JRC WP - C(2019) 1872 final.

Methodology

The results of the 2018 survey on AI@JRC were presented. The consultation was run from the 18th of May to the 06th of June 2018. The questionnaire was completed by 108 respondents (74% men and 26% women) from 29 different Units of JRC. Almost 90% were JRC Contract Agents and Administrators.

The survey results show a well-established and on-going activity by the JRC staff, in the diverse AI areas. All the proposed macro areas are presently covered by one or more activities, at JRC. However, almost half of these activities deal with Machine Learning and Deep Learning (with a clear predominance of Machine Learning). Knowledge Representation, Big Data Stewardship, and Natural Language Processing together cover another 30% of the JRC activities, in the AI realm.

JRC Staff expressed an overwhelming interest in AI (as average, four AI areas were indicated by each respondents). Deep Learning and Machine Learning are still the most popular areas, however, this time, they cover "only" the 30% of the entire interest expressed by the JRC staff; the remaining 70% is well distributed among all the other areas. Several respondents expressed interest in areas that are not her/his present working ones. Based on the expressed interest, several AI areas show an extraordinary potential growth rate, in respect to the present activity.



For AI activity at JRC, in the 80% of the cases the utilized data types are: Time Series, Text, Geospatial and Images. More than 75% of the JRC activities, in the AI realm, address either Descriptive or Predictive problems, utilizing Structured (43% of the cases) and Semi-structured data (33% of the cases). Supervised and Semi-supervised learning problems are the most common at JRC. Unsupervised learning concerns the 31% of the activities and Reinforcement learning "only" 4%. More than 200 pre-processing and learning techniques were indicated. Data Bases (both relational and not) are the most utilized storage technology, at the JRC, covering about the 65% of the AI activities. For about the 25% of the cases, file system is still used for data storage.

Scientific references

- S. Nativi and A. Gomez Losada. 2019. Artificial Intelligence at the JRC: Survey Results. Publications Office of the European Union. ISBN: 978-92-76-08847-9 (online). JRC117234.
- M. Craglia (Ed.) 2018. Artificial Intelligence: A European Perspective. Publications Office of the European Union. ISBN: 978-92-79-97217-1 (online). JRC113826.

10 Conclusions

More than 60 Authors contributed to the event. All the colleagues were brilliant in communicating their scientific activity in less than 5 minutes.

In comparison with the first event, according to the JRC Director General Vladimír Šuchav, the **activities and results presented in this second workshop demonstrated a significant development of AI research and applications by JRC in different policy areas**. He suggested to think about replicating the event at the premises of diverse policy DGs in order to present and discuss the clear opportunities created by JRC activities.

Various colleagues are working on scientific aspects of common interest, such as AI transparency, accountability, robustness, liability, etc. There exists the need to **help people in connecting, sharing knowledge and collaborate on common goals**.

It is noteworthy the **increasing demand of computing capacity and understand how to make the JRC ICT infrastructure operational**, addressing the growing number of AI applications. A clear example is represented by the increasing number of JRC colleagues who utilize JEODPP (JRC Earth Observation Data and Processing Platform).

Some Units are working on AI (not scientific) aspects that are of particular relevance; they include AI use to: (a) identify experts and manage them, (b) extract data/knowledge from documents, (c) identify a better communication. It is important to listen to the lesson learnt and widely apply the best practices and/or guidelines, developed by a single group.

10.1 What next?

We need to make a **better use of the competences available at the JRC**, by connecting people through working groups/task forces to work together on specific topics. The AI&BD CoP might be the platform to facilitate such a process.

We need to use this expertise to **help the development of the future regularity framework on AI**, proposed as a priority by the new Commission. We need all the **JRC experts contributing to AI Watch** in order to monitor the evolution, uptake and impact of AI for Europe. Evidence collected by each Unit, working on AI, will play a crucial role for future policy and regulatory interventions.

Time being, we need to **raise the visibility about the competence and the work done by JRC**. We have a lot to show and as proposed by the former DG, Vladimír Šuchav, we should organise a roadshow to better communicate the relevance of our work to each single Directorate General.

We should **produce short policy brief reports** (e.g. on AI and Health, AI and Agriculture, AI and Security) that will be instrumental for the design of future sectoral policies.

Future editions of the AI@JRC workshop should be open to all the Commission Services –including the possibility to have presentations from them.

Furthermore, we need **to affirm JRC as an AI international player**, by increasing a number of strategic partnerships and by strengthening our role on AI standardisation.

List of abbreviations

AI	Artificial Intelligence
BD	Big Data
CAP	Common Agricultural Policy
CAS	Centre for Advanced Studies
CERN	European Organization for Nuclear Research
COM	European Commission
DL	Deep Learning
EC	European Commission
ESA	The European Space Agency
EU	European Union
EUSC	European Union Satellite Centre
JRC	Joint Research Centre
ML	Machine Learning
MS	(EU) Member States
NLP	Natural Language Processing
OJ	Official Journal of the European Union
SML	Symbolic Machine Learning

Annex 1. Workshop agenda

2nd AI@JRC workshop AGENDA

5th July 2019

- ***Location: ISPRA Auditorium*** *plus VC rooms (see below)*
- IPR-Room 11 Auditorium
- BRU-CDMA 04/A186
- SVQ-ROOM A41 / 30 SEATS
- GEE-ROOM- -50/01
- KRU-VC2-C2.23
- PTT-Room 309-015

Time	Title	Presenter
09:30	*Opening*	Vladimir Sucha
09:40	*AI@JRC one year late*	Alessandro Annoni
10:00	*AI@JRC competence mapping and CoP*	Stefano Nativi
	FLASH PRESENTATIONS	
10:30	*AI WATCH: Definition of Artificial Intelligence*	Montserrat López Cobo
10:35	*HUMAINT Project* *-Explaining Algorithmic Discrimination* *- AI Impact on Job* *-Human-Robot Interaction*	Vasiliki Charisi and Songul Tolan
10:50	*How can an AI be fooled?*	Henrik Junklewitz
10:55	*AI and Health*	Mauro Petrillo
11:00	*Health care, Chemical safety and AI*	David Asturiol
11:05	*Can AI support the regulation of innovative health products? Case study: Nanomedicines*	Susanne Bremer-Hoffmann
11:10	*AI4CRA - Artificial Intelligence for Chemical Risk Assessment*	Clemens Wittwehr
	COFFEE BREAK	
11:35	*Monitoring the business cycle with aspect-based sentiment extraction from news*	Sergio Consoli
11:40	*Multilingual Sentiment and Emotion Classification using Machine Learning - Developments and Applications*	Alexandra Balahur
11:45	*Applied machine learning in CAP- Checks by Monitoring*	Pavel Milenov
11:50	*Computer vision & crowdsourcing for crop and agri-environmental monitoring*	Marijn Van Der Velde
11:55	*Machine learning for Multi-Class Segmentation of Sentinel-2 Imagery*	Blagoj Delipetrev
12:00	*AI for improving the European Settlement Map*	Christina Corban

12:05	*The Global Conflict Risk Index*	Matina Halkia
12:10	*Time series forecasting by recommendation: an empirical analysis on Amazon Marketplace*	Alvaro Gomez Losada
12:20	*Loan Default Analysis in Europe: Tracking Regional Variations using Big Data*	Luca Barbaglia
12:25	*Clustering and Unsupervised Learning for Digital Forensics – An Update: Unsupervised Video Forensics*	Henrik Junklewitz
12:30	*JRC Big Data Platform and Big Data Analytics*	Vasileios Syrris
12:35	*TES's Thematic Key Areas of Strength*	Montserrat López Cobo
12:40	*SETA: Semantic Text Analyzer*	Jiri Hradec
12:45	*Robust Indoor Localization in Complex Scenarios (RISE)*	Carlos Sanchez Belenguer
12:50	*Wrap up*	Alessandro Annoni

Annex 2. Sections text references

The introductory text of each section of this report was elaborated from the following sources:

Green Deal

- European Commission, 2020, "A European Green Deal: Striving to be the first climate-neutral continent". https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
- European Commission, 2020, "White paper on Artificial Intelligence - A European approach to excellence and trust". COM(2020) 65 final.
- European Commission, 2020, "Shaping Europe's digital future". COM(2020) 67 final.
- European Commission, 2020, "A European strategy for data". COM(2020) 66 final.

Industry and Manufacturing

- European Commission. 2019. "Shaping Europe's digital future: Common European data spaces for Smart Manufacturing". https://ec.europa.eu/digital-single-market/en/news/common-european-data-spaces-smart-manufacturing
- European Commission. 2018. "Shaping Europe's digital future: policy: Digitising European Industry". https://ec.europa.eu/digital-single-market/en/policies/digitising-european-industry
- European Commission. 2018. "Shaping Europe's digital future: policy: Smart Manufactoring". https://ec.europa.eu/digital-single-market/en/policies/smart-manufacturing
- European Commission, 2020, "White paper on Artificial Intelligence - A European approach to excellence and trust". COM(2020) 65 final.
- European Commission, 2020, "Shaping Europe's digital future". COM(2020) 67 final.
- European Commission, 2020, "A European strategy for data". COM(2020) 66 final.

Health

- European Commission. 2020. "Shaping Europe's digital future: Policies: Managing health data". https://ec.europa.eu/digital-single-market/en/managing-health-data
- European Commission, 2018, "on enabling the digital transformation of health and care in the Digital Single Market; empowering citizens and building a healthier society". COM(2018) 233 final.
- European Commission, 2020, "A European strategy for data". COM(2020) 66 final.

Finance, Insurance and Market

- European Commission, 2019. "Workshop on promoting a data-driven finance and insurance sector". Luxembourg, 2 July 2019.
- European Commission, 2020, "A European strategy for data". COM(2020) 66 final.
- European Commission, 2020, "White paper on Artificial Intelligence - A European approach to excellence and trust". COM(2020) 65 final.

Agriculture

- European Commission, 2019. "Workshop on promoting a data-enabled agricultural sector: towards a common European data space in agriculture". Brussels, 4 July 2019.
- European Commission, 2020, "White paper on Artificial Intelligence - A European approach to excellence and trust". COM(2020) 65 final.
- European Commission, 2020, "Shaping Europe's digital future". COM(2020) 67 final.
- European Commission, 2020, "A European strategy for data". COM(2020) 66 final.

Public Administrations

- European Commission, 2019. "Workshop on creating a common European data space in public services". Luxembourg, 10 Sep 2019.

- European Commission, 2020, “A European strategy for data”. COM(2020) 66 final.
- European Commission, 2020, “White paper on Artificial Intelligence - A European approach to excellence and trust”. COM(2020) 65 final.

Security and Safety

- European Commission, 2020, “A European strategy for data”. COM(2020) 66 final.
- European Commission, 2020, “White paper on Artificial Intelligence - A European approach to excellence and trust”. COM(2020) 65 final.
- European Commission, 2020, “Shaping Europe's digital future”. COM(2020) 67 final.

Skills and Ethics

- European Commission, 2020, “A European strategy for data”. COM(2020) 66 final.
- European Commission, 2020, “White paper on Artificial Intelligence - A European approach to excellence and trust”. COM(2020) 65 final.
- European Commission, 2020, “Shaping Europe's digital future”. COM(2020) 67 final.

JRC AI&BD Community of Practice

- JRC AI&BD Community of Practice home page, https://webgate.ec.europa.eu/connected/groups/community-of-practice-ai-and-big-data

Acknowledgement

We are particularly grateful to all the participants and contributors of the second workshop on Artificial Intelligence at JRC.

We also want to thank Nicholas Spadaro and Karen Fullerton for their important help in the workshop and report preparation and all the other JRC colleagues that made good suggestions for this successful event.

Finally, a special recognition to Alessandro Annoni who inspired the AI@JRC workshops initiative and activities.

GETTING IN TOUCH WITH THE EU

In person

All over the European Union there are hundreds of Europe Direct information centres. You can find the address of the centre nearest you at: https://europa.eu/european-union/contact_en

On the phone or by email

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

- by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),

- at the following standard number: +32 22999696, or

- by electronic mail via: https://europa.eu/european-union/contact_en

FINDING INFORMATION ABOUT THE EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website at: https://europa.eu/european-union/index_en

EU publications
You can download or order free and priced EU publications from EU Bookshop at: https://publications.europa.eu/en/publications. Multiple copies of free publications may be obtained by contacting Europe Direct or your local information centre (see https://europa.eu/european-union/contact_en).

KJ-02-20-368-EN-N

The European Commission's science and knowledge service

Joint Research Centre

JRC Mission

As the science and knowledge service of the European Commission, the Joint Research Centre's mission is to support EU policies with independent evidence throughout the whole policy cycle.

EU Science Hub

ec.europa.eu/jrc

@EU_ScienceHub

EU Science Hub - Joint Research Centre

Joint Research Centre

EU Science Hub

Publications Office of the European Union

doi:10.2760/511755

ISBN 978-92-76-18943-5