Deep Learning Techniques for Image Analysis

Assicurazioni Generali

Mishel Qyrana

16th March 2022

Innovation

Customer Relationship Management

Data, Analytics & AI

Agile Organization

Smart Automation

GENERALI DIGITAL

Agenda

1 **Introduction**

2 **Experience Overview**

3 **Focus on main activities**

4 **Conclusions and Q&A**

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Speakers

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Control Engineering

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About me

2016 — Bachelor's Degree in Business Administration

2018 — Master's Degree in Economics and Finance

2019 — PhD in Computational Mathematics

I got an industrial PhD scholarship in «Computational Mathematics and Decision Sciences» at the Mathematics department of University of Pavia. My scholarship is sponsored by Generali, with «Machine Learning ad Deep Learning for Image Recognition» as core research topic.

The Generali Group is one of the leading insurers in the world

" The **Group**'s Parent Company is **Assicurazioni Generali**, founded in 1831 in Trieste. "

50 countries

65.9 million customers

Almost **72,000** employees

664 billion Euro of Total AUM

70.7 billion Euro in premiums over 64% from outside Italy

Among the **top 100** sustainable companies *
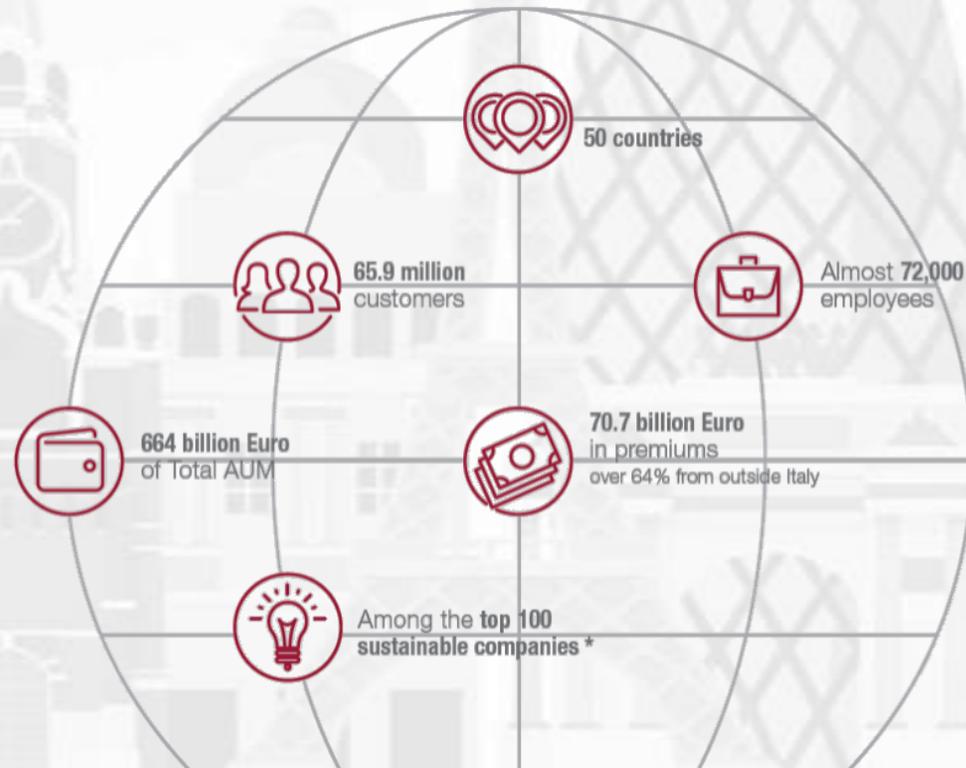
The Generali Group is one of the leading insurers in the world

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GLOBAL PRESENCE

Lifetime Partner Behaviours

50 countries

65.9 million customers

Almost **72,000** employees

664 billion Euro of Total AUM

70.7 billion Euro in premiums over 64% from outside Italy

Among the **top 100** sustainable companies *

OWNERSHIP
Act with proactivity and passion for excellent performance

SIMPLIFICATION
Make things simple, adapt quickly and take smart decisions

HUMAN TOUCH
Partner with others, showing empathy and team spirit

INNOVATION
Embrace differences to make innovation happen
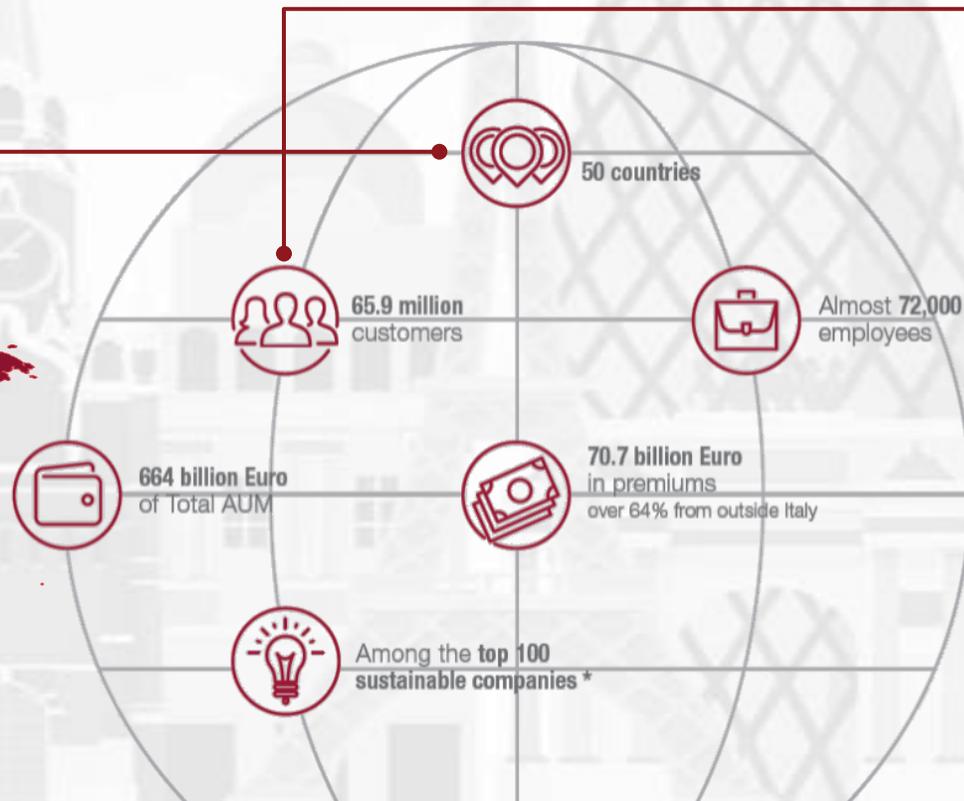
Our team: Analytics Solutions Centre at a glance

Our **Mission** is to **support the adoption of Analytics & AI** through our highly specialized **technical skills** and our extensive **hands-on project experience**

Data Scientist

Business Translator

DS Team

- 3 Engineers
- 2 Mathematicians
- 1 Actuary

- 33% not Italians
- 3 countries
- 2 continents

Analytics Solutions Centre

Use cases (marketing, pricing, claims, ops)

Technology (predictive, ML, computer vision, NLP, etc.)

Community of Practice / Experts
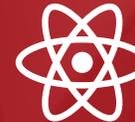
Knowledge mgmt. and sharing, etc.

Solution design and algo's selection

Technology / vendor evaluation

Training / shadowing

Market trends and benchmarking, etc.

Data processing / preparation

Champion-challenger modeling, etc.

Algorithms development

Central assets development

Model prototyping and testing

Research & development

GENERALI

IMAGE ANALYTICS ECOSYSTEM

Unlock the power of images

FOUNDING PRINCIPLES

Support Generali's digital transformation through the collaborative and open development of Image Analytics solutions, enabling all BUs to unlock the value of images to address business challenges

A shared environment

A collaborative Ecosystem

A flexible offering

Open to open innovation

Images

The Image Analytics Ecosystem now count more then **3 millions** of images coming from **~20 BUs**. This informative asset enable R&D and new product developments.

Datasets

105K labeled images have been organized in **39 Datasets** to train the IA models undelaying the Ecosystem. These are priceless assets that will be used for maintenance and R&D.

Models

The Image Analytics Ecosystem count **22 Models** that enable its **18 IA Capabilities**. These models are the engine of the Smart Gallery, baseline for benchmarking and starting points for future developments at Group level.

Repositories

Each Image Analytics Capability comes with its **repository*** including code and documentation. These repositories are global assets accessible from every Analytics Team in the Generali Group.

*repositories are available for both development and deployment, and can be accesses by request

GENERALI | IMAGE ANALYTICS ECOSYSTEM

Where we are and future challenges
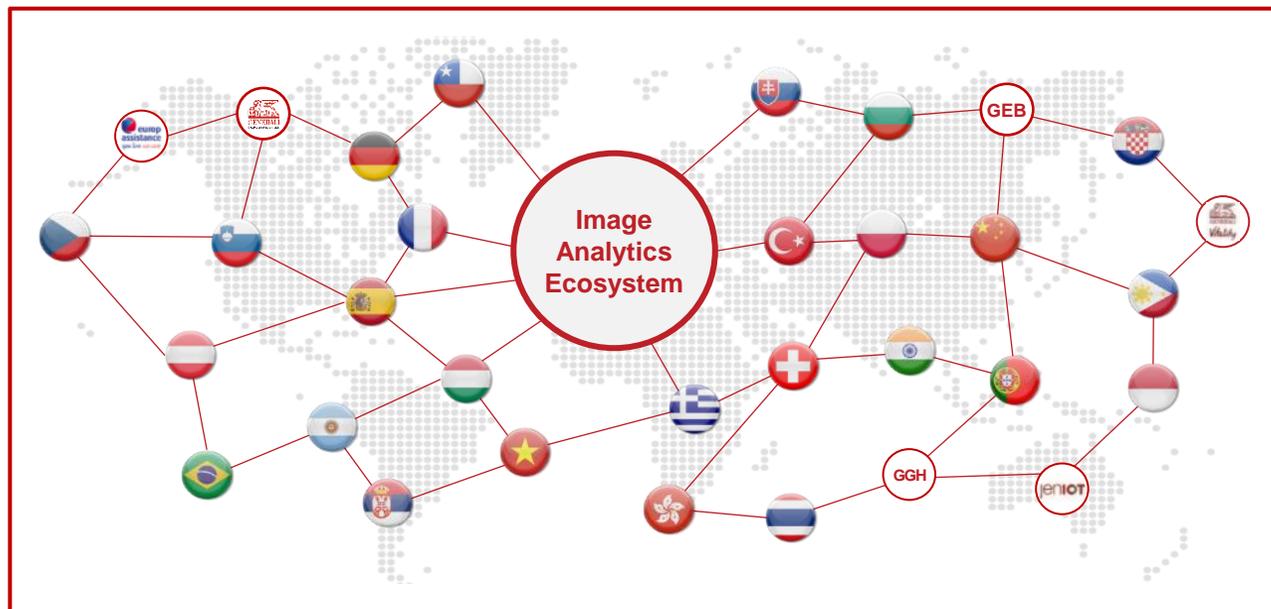
Assets

- **1 Cloud Platform**
- **18 Capabilities**
- **22 Repositories**
- **32 Datasets**
- **20 Models**
- **3M+ Images**

Opportunity

International

From design to production

Drive the innovation

Challenges

- Heterogeneous Data **sources** with different **quality**
- Guarantee **generalization** for worldwide usage
- High **complexity** to coordinate
- Inference **optimization** with **GPU** acceleration
- Apply **SoA** techniques

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Opportunities in my industrial PhD experience

The PhD experience was formative from a variety of perspectives, some of which were unexpected

Drive your own grow

**A concrete work experience**

Networking and market visibility

Collaboration with top tier Universities
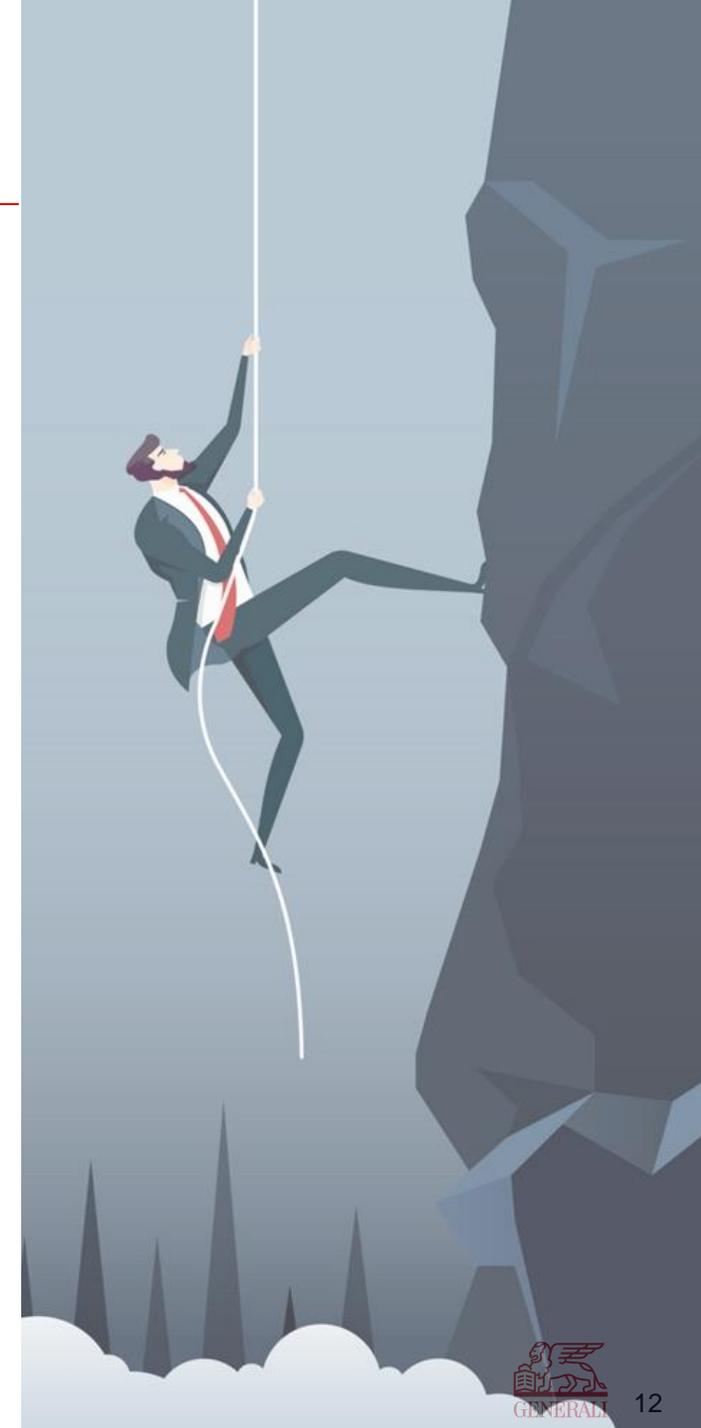
Main activities and opportunities in Generali

The cooperation with Generali Analytics Team was at core of my PhD; it gave me a variety of benefits which whose ramifications have also indirectly affected all my doctoral activities:
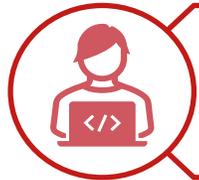
The possibility to touch for the first time Machine Learning and Deep Learning areas by a **Learn by Doing approach**, which allowed me to come back to theoretical results with an improved awareness.

A **concrete direction** which defined and inspired my research activities, providing for them order, structure and hierarchy, and then guaranteeing an excellent consistency to my PhD path.

The chance to **report** my results **to Top Management**, improving in this way all those skills which are fundamental in a business context to correctly align the team with respect to objectives and tools.

Cooperation with different teams and areas inside the Generali Group, which has proven to be fertile grounds **for multidisciplinary applications**.

Other companies' experiences

PROFESSIONAL GROWTH

- Replication of my educational experience
- Scalability of acquired skills
- Improvement of my working attractiveness
- Absorption of new expertises

*The **Generali** Experience gave me a lot of know-how both in terms of technical skills and project management. This professional growth enhanced my performances during other companies collaborations.*

KEDA

AI solutions for Business.

TASKS: I selected two candidates to form my team and followed their educational path, elaboration of algorithms, management and customers alignment.

ALPHA CAPITAL

Python based solutions for **automated trading and investing**.

TASKS: Elaboration and coding of models and algorithm, HR task in order to catch well-suited talents for the company.

BENEFITS

- The possibility to consider and merge together different perspectives about costs and benefits; balance between scientific and business/applicative needs.
- Responsability for what you think you know: nobody can amend your errors until project becomes production.
- A maieutichal process

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Three pillars of my collaboration with Generali

During my PhD with Generali I had the opportunity to join a pletora of activities really wide and deep, which afferred different areas and styles of work and involved the chance to build a variety of skills.

Technical Upskilling: bidirectional contributions among me and the Generali Team I had the chance to join in terms of technical deep diving

Work Experience: I had the opportunity to attend both ongoing projects and end to end projects, reporting to the team and the management

Dissemination and Research: as a Generali team member I was offered the chance to join international research studies and at the same time to propose personal contributions sourcing from my PhD research.

Technical upskilling
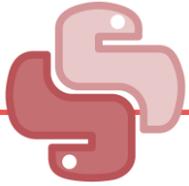
Internal Training

A series of internal training, during which the members of the team shared their technical experience – coding and modelling – as well as their know-how in terms of project management.

TAKER

Literature Deep Diving

Paper deep analytical review, analysis of the links among problems and literature offered solutions, tasks criticalities detection.
Bidirectional benefits: a maieutichal process.

GIVER AND TAKER

- ❑ Complementary needs among and benefits with respect to the team

- ❑ Sinergic skills and competences growth

- ❑ Expertise scalability: I broadcasted what I learned

Work Experience

ONGOING AND END TO END PROJECTS I WAS INVOLVED IN

SMARTGALLERY

**Smart Gallery
Project**

**Damaged Smartphone
Project**

Images allow an immediate and faithful understanding of the claim…

~90 Million | **motor claims images** taken in Generali every year[1]

~50% of time | spent by claims operators **analyzing motor claims images**[2]

…without the right tools and technology this opportunity goes wasted

…but…

Opportunity

Current Claims Management Systems (CMS) are not designed for an efficient and effective **analysis of claims images**.
We want to **empower claims operators** in this important phase supporting their decision making

1: 3 million yearly claims with an average of 30 images per claim, as observed in Smart Gallery tests; 2: Interviews to Smart Gallery tests participants, considering workflows that need photo analysis

Designed for Generali people by Generali people

Secure and scalable solution complementary to any CMS

A new focus on image analysis to empower claims team performance

GENERALI | SMARTGALLERY

SMARTGALLERY

Unlock the power of images to support claims operators at Generali

UX: Put images at the centre

Handy AI-powered gallery
to simplify and speed up access and analysis of claims images

*A combination of advanced UX and AI to get the best out of our images*

AI: Add superpowers

A set of Image Analytics controls
to provide an exhaustive summary of the insights from images and empower decision making

Designed for Generali people by Generali people

Secure and scalable solution complementary to any CMS

A new focus on image analysis to empower claims team performance

GENERALI | SMARTGALLERY

Smart Gallery: my contributions

*Thanks to the Smart Gallery I had the chance to join a very vast **E2E project**, which gave me the opportunity to contribute to different phases, then facing different challenges, practical issues and developing insights on problems and intuitions about solutions.*

Dataset Labeling:
This kind of task gives a precise idea of real-world applications and a lot of sneaky and tricky issues involved by the technical task are detected, then allowing to better catch the nature of the problem you are working on

License Plate Detection:
I joined an ongoing process with an underlying model. My task was to try new approaches and some experimental trials in order to improve the performance and the model, starting from the existing one.

Mask R-CNN:
Paper analysis, model deconstruction and brainstorming with the team on criticalities, details, potential issues and improvements with respect to one of the adopted models for the Smart Gallery functionalities

Smartphone Damaged Screens Project

| Business Context	Proposed Solution

Generali Sigorta is developing a new **protection product for mobile phones**, both brand new or second-hand.
 	
- **Claim handling** → the process will be outsourced and will include the gathering of pictures of the damaged phone.
 	
The goal of Generali Sigorta is to **automate smartphone with damaged screen recognition** through the use of **Image analytics algorithms**.
	- **MODEL 1 «Phone detection»**
	
	  • **Image Classification**: Based on the taxonomy «Phone/NoPhone».
	  • **Model Goal**: The model aims to assess if the input picture represents a smartphone or not.
	
	- **MODEL 2 «Screen classification»**
	
	  • **Image Classification**: Based on the taxonomy «Broken/Unbroken».
	  • **Model Goal**: The model aims to assess if the smartphone in the input presents visible damages on the screen or not.

Broken screen

Unbroken screen
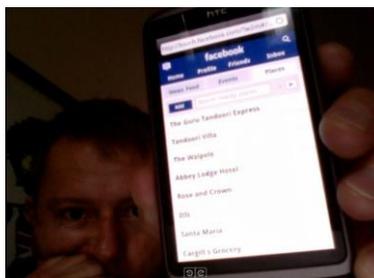
Other tricky

# Test set results

MODEL 1

Confusion matrix

	NoPhone	Phone
NoPhone	0.9507	0.0493
Phone	0.0351	0.9649

True label / Predicted label
accuracy=0.9595; misclass=0.0405

Accuracy: 95.95%

MODEL 2

Confusion matrix

	broken	unbroken
broken	0.9882	0.0118
unbroken	0.0000	1.0000

True label / Predicted label
accuracy=0.9904; misclass=0.0096

Accuracy: 99.04%

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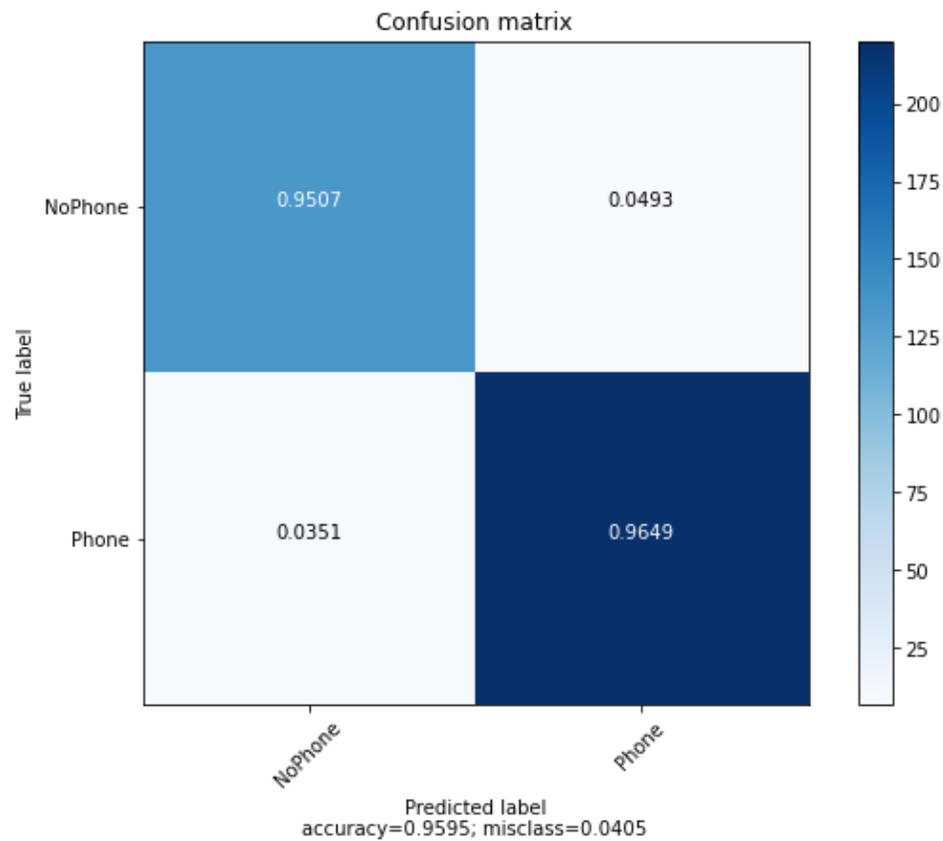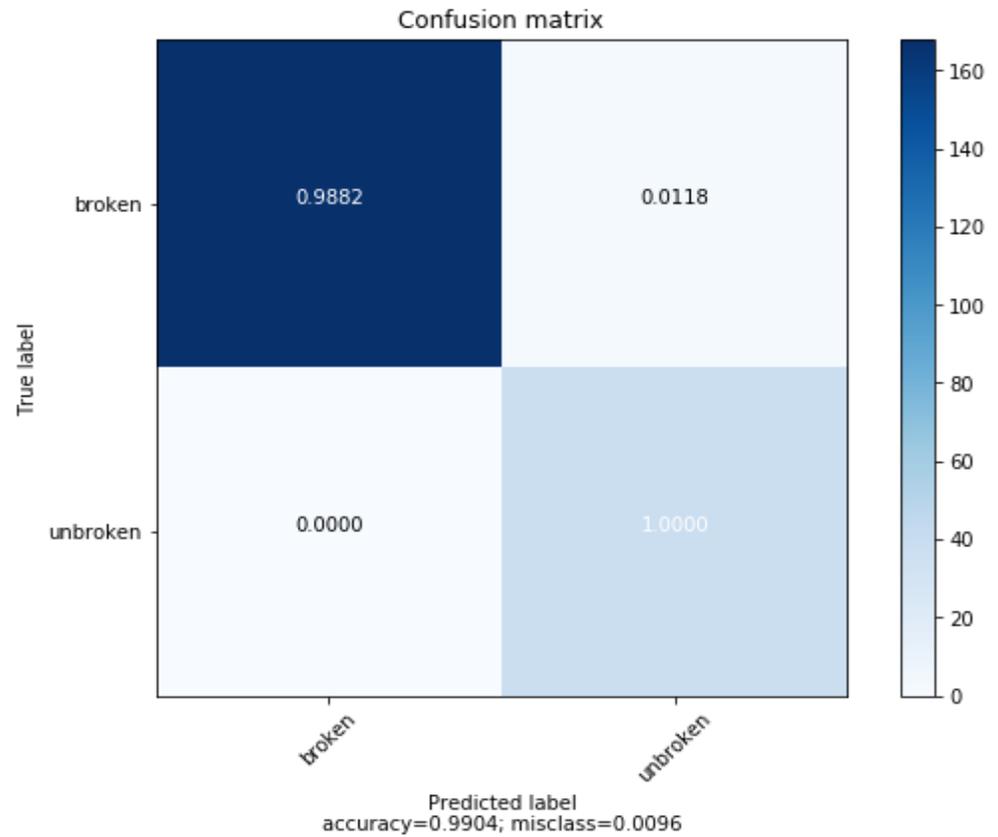
Dissemination and research
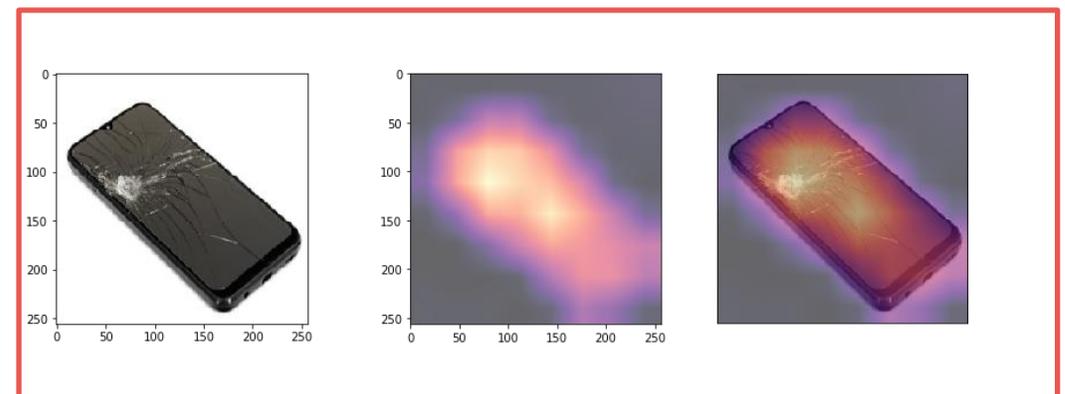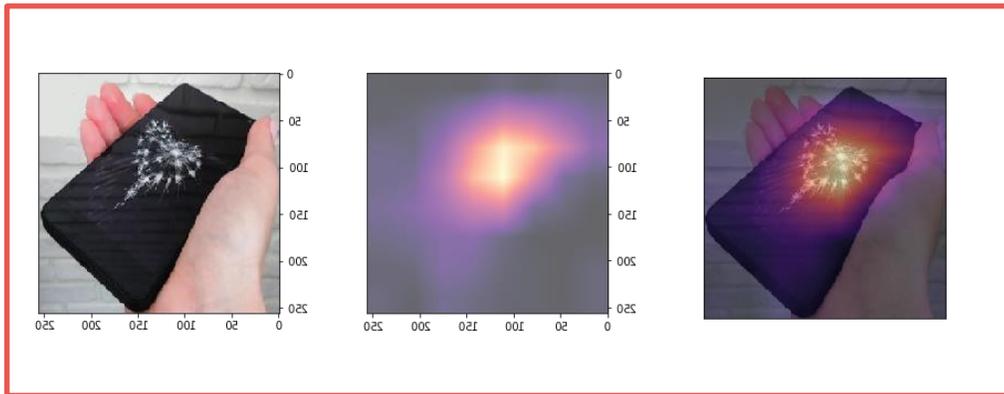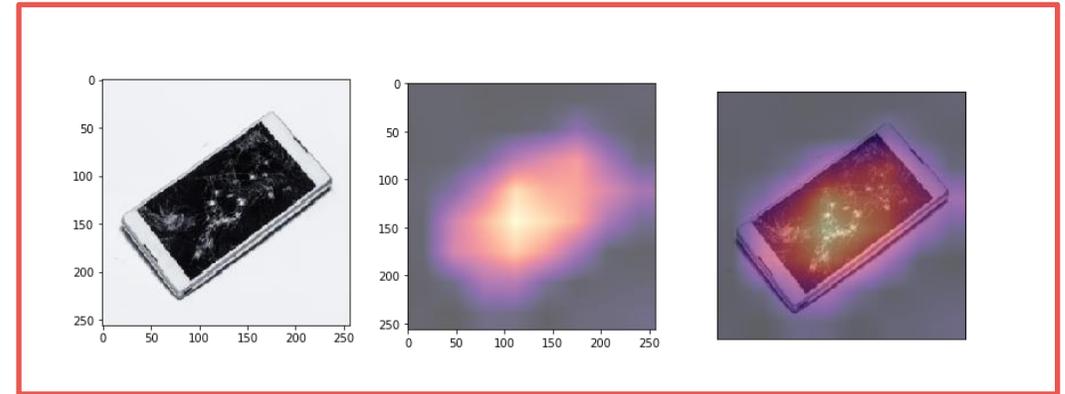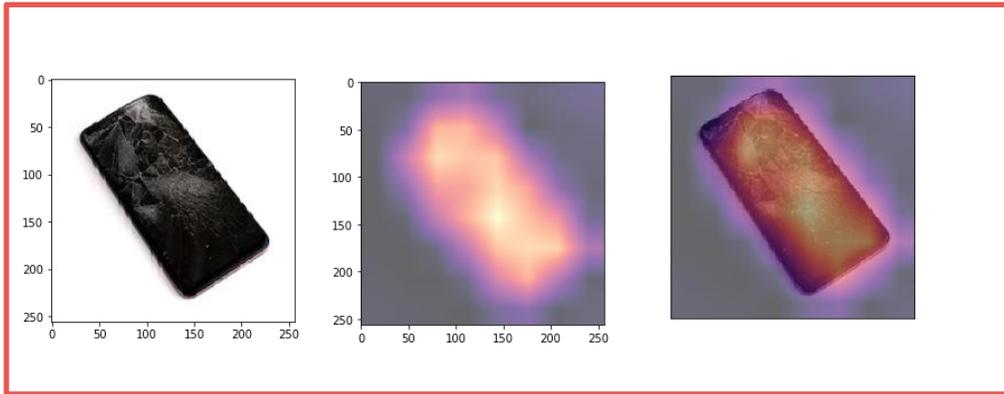
DISSEMINATION AND RESEARCH TOPICS AND OPPORTUNITIES

«Responsible Digital Leadership» – Ethical dilemmas in AI applications

Computer Vision techniques for financial application

Stanford Project – Responsible Digital Leadership

Through my cooperation with Generali Group, I was selected for a project created and organized by the Stanford University about AI ethical challenges. The projects involved students and practitioners from all the world, with different and complementar educational background.

Blockchain: conflict between immutability and the right to be forgotten

Smart Contract: conflict regarding legal translatability, and between immutability and the state of good faith.

Cryptocurrencies: market manipulation and investor psychology in the post-pandemic and post-influencers era.

Board Game and **Online Game**: board and online game creation, which allows to players to face all the challenges and ethical dilemmas related to AI issues

STARTING NOW

Ethical Dilemmas Library: the first step was to create a library of well-posed ethical dilemmas which may arise in the context of AI applications in business

DONE

Discussion and **analysis** of ethical dilemmas related to **AI applications** in differente areas: Business, Insurance, Climate Change, Finance, Credit Lending etc.

Portfolio Optimal Allocation: that is how to compute the optimal weigths of a portfolio, by taking in account non linear relationships among the assets.

*We did some preliminary test on different datasets, in order to assess the advantages of AI based techniques in **asset allocation** in order to improve traditional models:*

AI enhanced Portfolio Models **VS** Traditional Portfolio Models
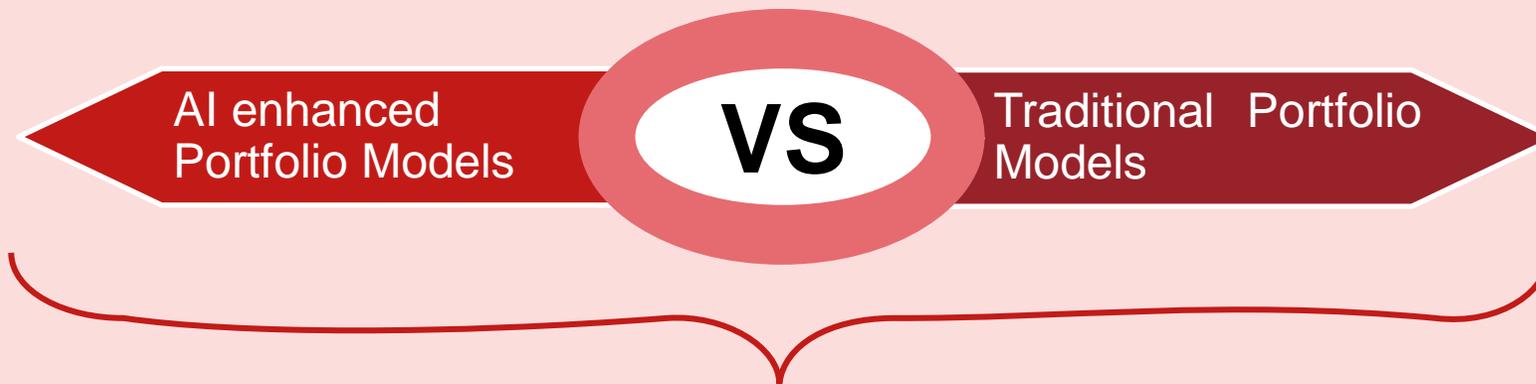
Assessed through common performance metrics adjusted for risk:

- **Sharpe Ratio**: mean return adjusted for standard deviation
- **Sortino Ratio**: mean return adjuste for negative standard deviation

ANNUALIZED

Equity Lines: Portfolio P, Portfolio Q
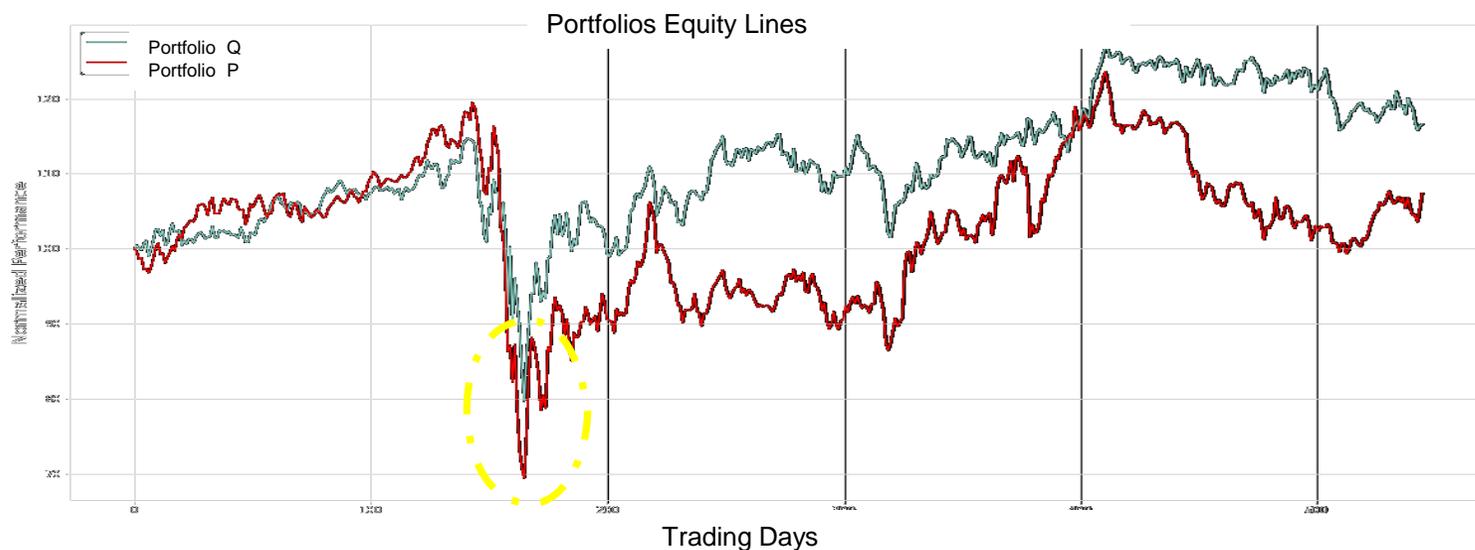
Portfolios Equity Lines

Portfolio P is obtained on an entire universe of stocks, while Portfolio Q is obtained by selecting a subsample of assets based on IA algorithms:

	Portfolio P	Portfolio Q
Sharpe	0.23	**0.65**
Sortino	0.41	**1.16**
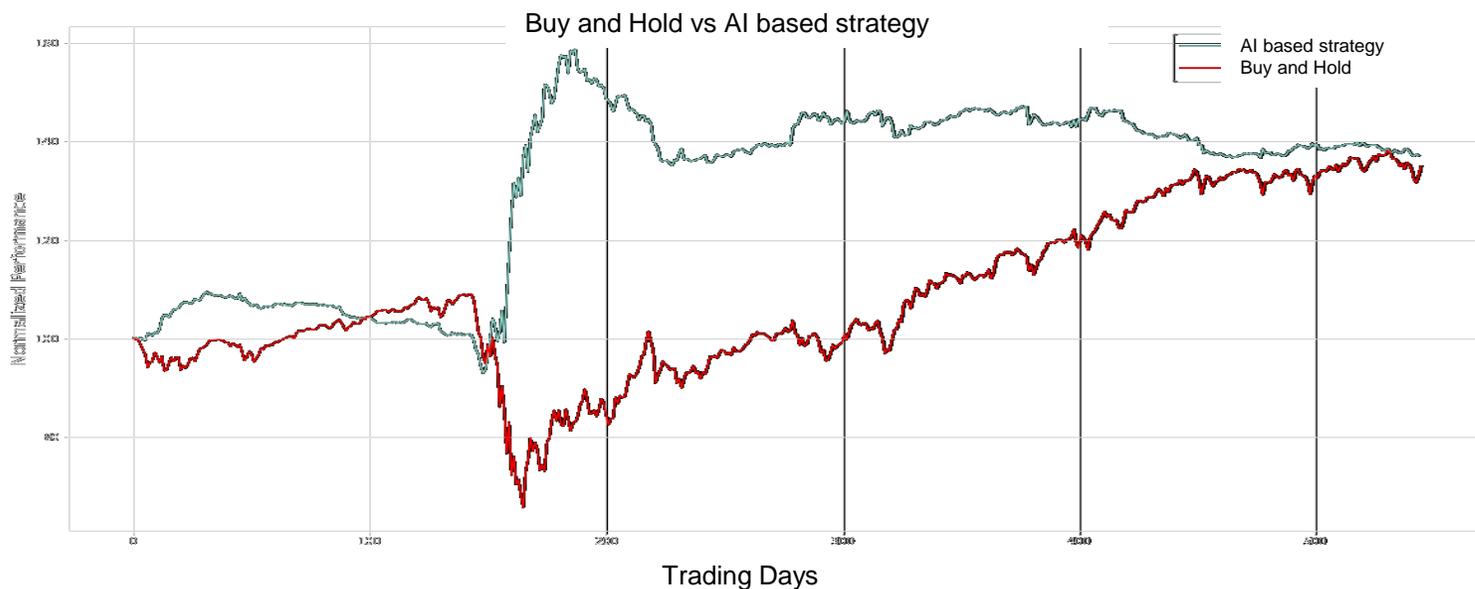
Buy and Hold vs AI based strategy

Buy and Hold strategy vs Trading strategy based on IA market anomalies detection:

	B&H	AI Strategy
Sharpe	0.74	**1.26**
Sortino	1.19	**2.77**
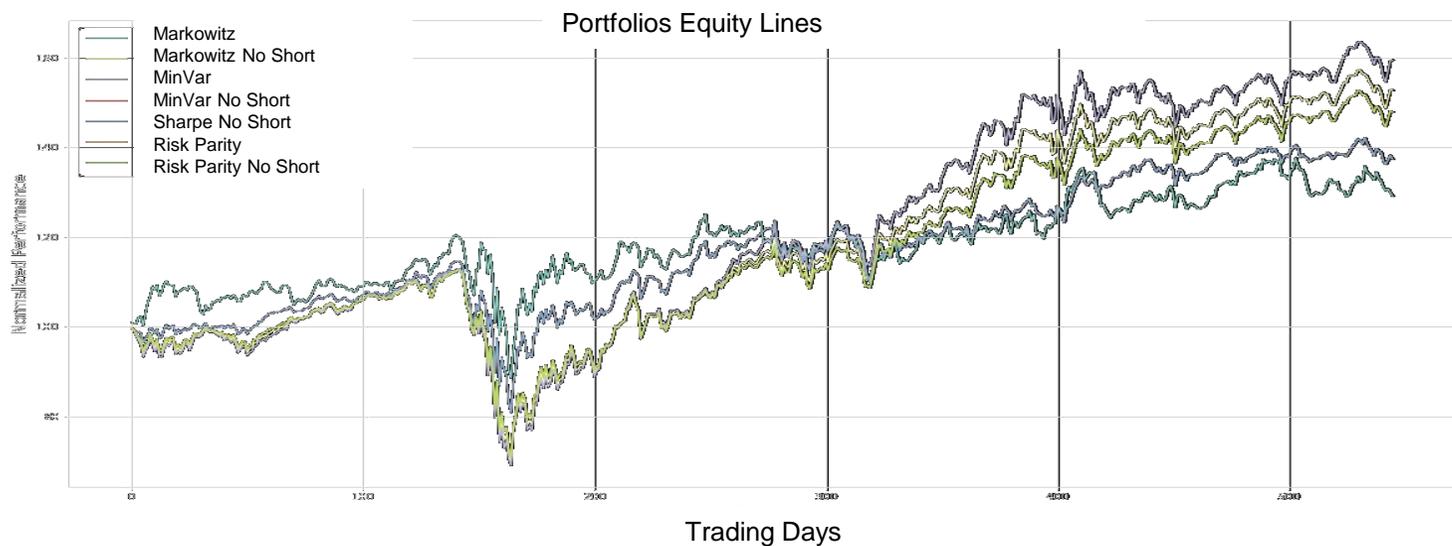
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Portfolios Equity Lines

Legend: Markowitz, Markowitz No Short, MinVar, MinVar No Short, Sharpe No Short, Risk Parity, Risk Parity No Short

Trading Days

Portfolio P is obtained on an entire universe of stocks, while Portfolio Q is obtained by selecting a subsample of assets based on IA algorithms:

	Portfolio P	Portfolio Q
Sharpe	0.40	0.64 (avg)
Sortino	0.56	0.91 (avg)
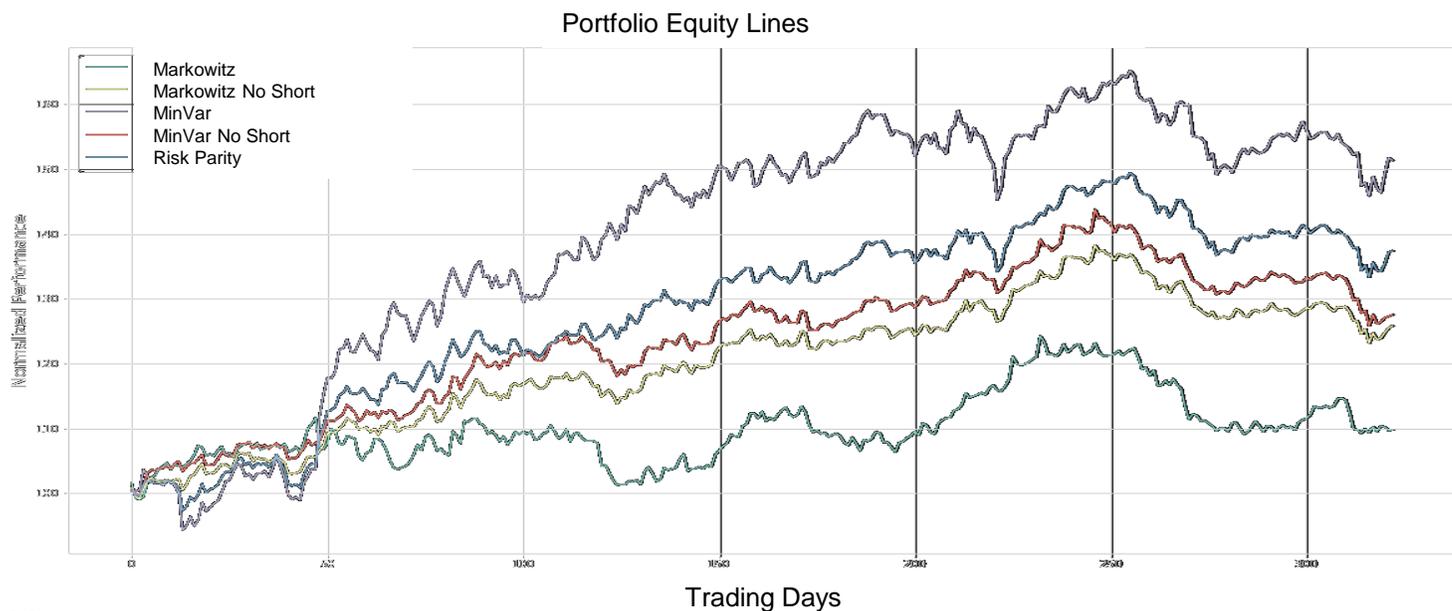
Portfolio Equity Lines

Legend: Markowitz, Markowitz No Short, MinVar, MinVar No Short, Risk Parity

Trading Days

Buy and Hold strategy vs Trading strategy based on IA market anomalies detection:

	B&H	AI Strategy
Sharpe	1.07	1.40 (avg)
Sortino	2.49	3.04 (avg)

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Conclusions

My industrial PhD was a synergic balance among studying and working, perfectly mixing the benefits

I gained attractiveness in the work market

Combination among a classic theoretical study and a learn by doing context

The chance to feed different personal research interests, distributed in different projects, tasks and roles

Network opportunities, mixing the academic context with the companies world

Q&A

Thank you!