Simona De Vivo

# Augmented AI for Sustainable Cyber Security in Railway Environment

Tutor: Prof. Domenico Cotroneo

Cycle: XXXVII

Year: First

# Presentation Organization

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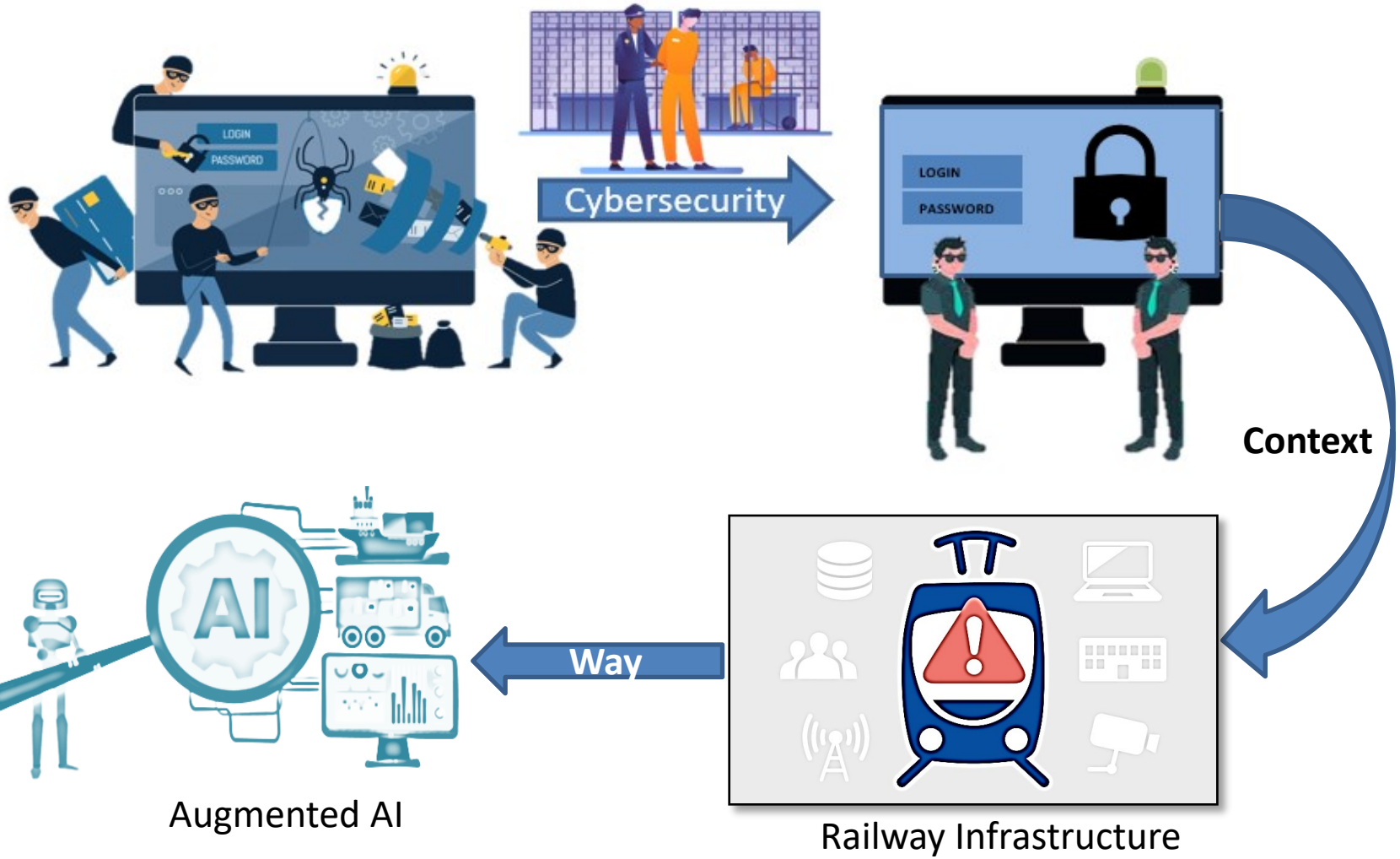
# My background

- I received my M.Sc. in Computer Engineering (cum laude) from University of Naples Federico II in October 2021
- I work within the DESSERT group at DIETI
- My PhD started on 1st January 2022
- **Type of fellowship:** PhD student grant – Type: MUR PON

# Research field of interest



# Summary of study activities

**Conferences / events attended:**

- The 1st Intl. Workshop on Natural Language-based Software Engineering  Co-located with ICSE 2022

**Seminars:**

- Rails Mid-Term Workshop
- Project Vāc: Can a Text-to-Speech Engine Generate Human Sentiments?
- Explainable Natural Language Inference
- An Introduction to Deep Learning for Natural Language
- QoE management in 5G networks
- Cybercrime and Information warfare: national and international actors
- Privacy and Data Protection
- Privacy-Preserving Machine Learning

**Ad hoc PhD courses / schools:**

- Virtualization technologies and their applications
- Statistical data analysis for science and engineering research
- Scientific Programming and Visualization with Python
- Imprenditorialità Accademica
- ARTISAN Summer School (Role and effects of ARTificial Intelligence in Secure ApplicatioNs)
- Machine Learning for Science and Engineering Research
- DataWeek (Python & Tableau)

**Courses borrowed from MSc curricula:**

- Data Security
- Critical Data Visualization

# Research activity: Problems

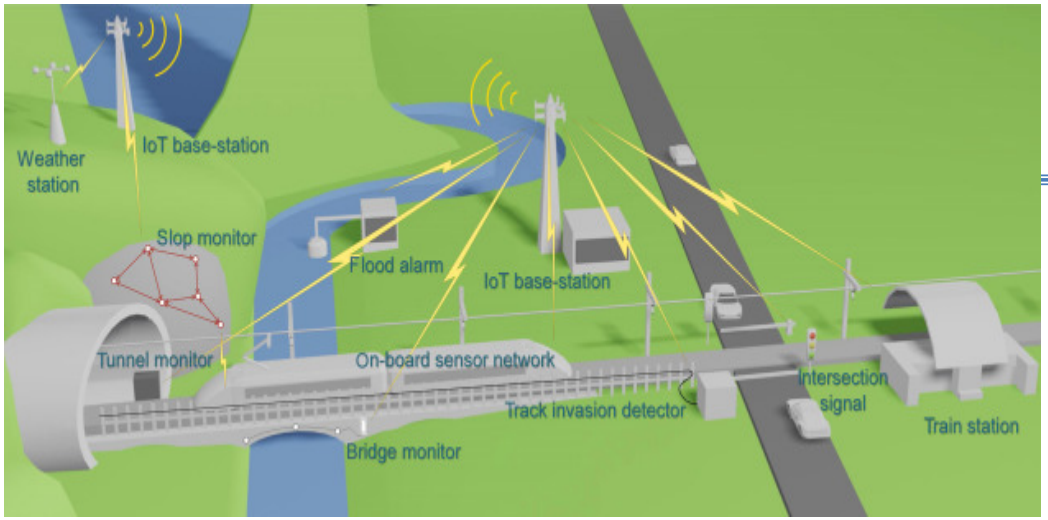
## Cybersecurity

- Data dumps and junk data;
- Use of artificial intelligence techniques (e.g., deep learning models) that are computationally very complex and result in excessive waste of resources;
- Emission of massive amounts of $CO_2$.

## Railway Infrastructure

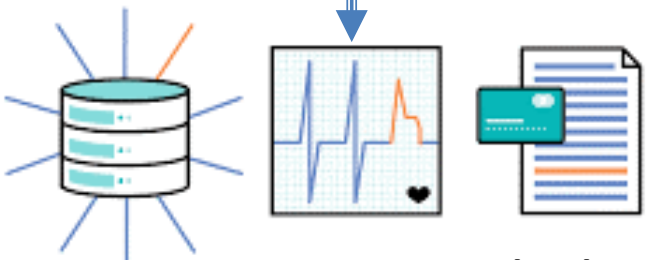
- Railway maintenance requires machines and operation that usually emit significant amounts of carbon;
- Railway infrastructure must satisfy safety regulations that include preventive maintenance;
- Cost optimization at every stage of the process, including maintenance;
- Maintenance of a wide variety of technological elements which are installed in railway infrastructure.

# Research Activity: Proposed Solution

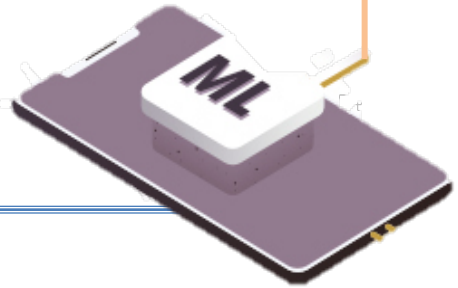



Collected Data

**Monitoring Solution**



**Anomaly Detection (AD)**




**Main Requirements:**

- **Real-Time** (e.g., Real-Time processing applied to anomaly detection)
- **Green** (e.g., transfer learning, distributed learning, TinyML, …)

# Research activity: Methodology


**..test the robustness of the monitoring solution?**

- **I will evaluate the accuracy in terms of metrics commonly used for anomaly detection (e.g., tre/false positive/negative rates).**

| | |
|---|---|
| **True negative**<br>Predicted negative<br>Actual negative | **False positive**<br>Predicted positive<br>Actual negative |
| **False negative**<br>Predicted negative<br>Actual positive | **True positive**<br>Predicted positive<br>Actual positive |

And


**.. assess the improvements made from an energy and computational point of view?**

- **I will evaluate the reductions in carbon emissions, energy consumption, execution time, the complexity of the models implemented, etc.**

# My Product

| | |
|---|---|
| Conference Paper | Liguori Pietro, Improta Cristina, **De Vivo Simona**, Natella Roberto, Cukic Bojan, & Cotroneo Domenico (2022). "**Can NMT Understand Me? Towards Perturbation-based Evaluation of NMT Models for Code Generation**". IEEE/ACM 1st International Workshop on Natural Language-Based Software Engineering (NLBSE), 2022. |

# Tutorship

- During the first year, I carried out 5 hours of tutoring as part of the "additional activities" called "Matlab and Simulink for Electrical Engineering".

# Future Activities

- Use of NLP techniques to monitor infrastructure and identify anomalies due to cyber attacks;
- Implementation of an intelligent attack analysis and detection solution using online data processing;
- Period abroad: University of North Carolina at Charlotte, under the supervision of the Dr. Bojan Cukic.

# Thank you!

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