



INTELLIGENCE IN ACTION: AI-DRIVEN NETWORKS

M1. Lifecycle objectives and calendar for the project

Projeto em Informática 2024/2025

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Rodrigo Abreu - 113626

Eduardo Lopes - 103070

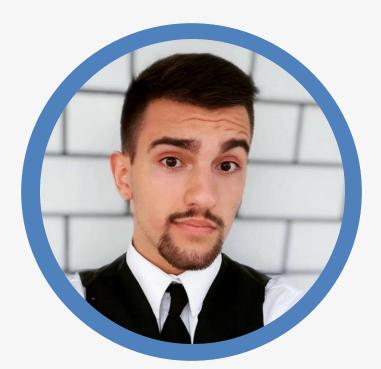
Jorge Domingues - 113278

Joao Neto - 113482



OUR TEAM





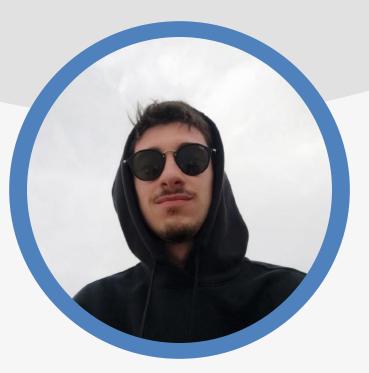
Hugo Ribeiro

Data Engineer
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Messaging & API
Engineer



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Team Manager Backend Engineer



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Jorge Domingues

Integration Engineer UI Engineer



João Neto

Data Engineer
Messaging & API
Engineer

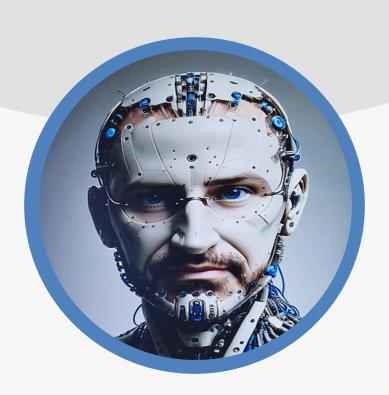


OUR TUTORS





Rafael Teixeira
Al Tutor



Rui Aguiar

Project
Supervisor



Rafael Direito
Networks Tutor

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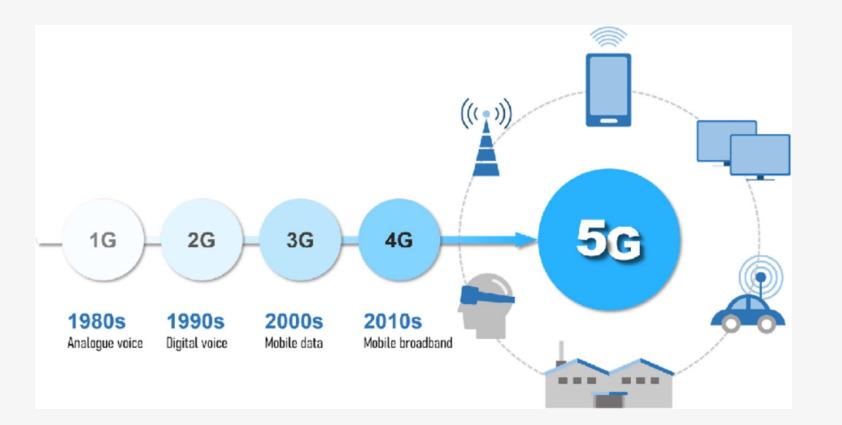
NETWORK CONTEXT

Networks have evolved significantly from traditional static infrastructures to more dynamic, intelligent, and adaptive systems.

5G and Beyond-5G networks must:

- handle vast amounts of data.
- support a diverse range of applications.
- ensure high reliability and low latency.

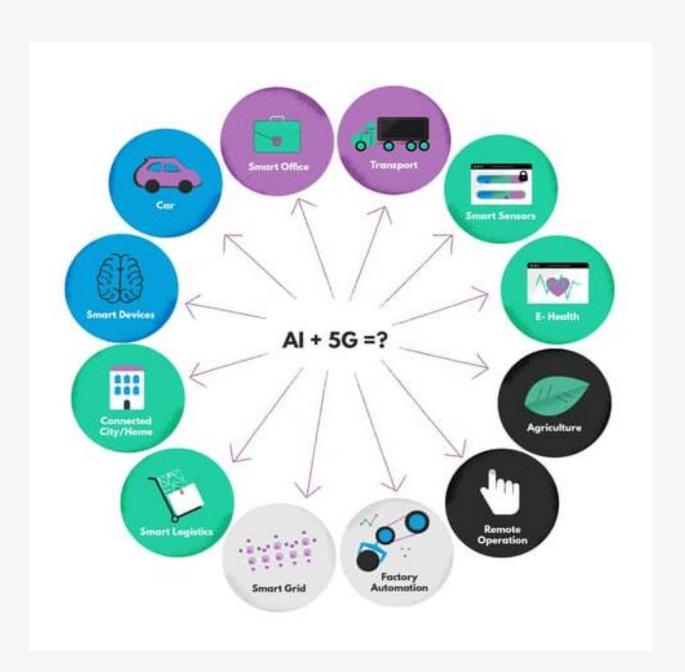
To achieve this performance, efficiency and adaptability requirements must be met.





ML CONTEXT

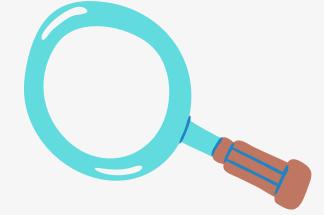
- Incorporating AI, ML and automation, is an innovative way of meeting these challenges.
- An MLOps pipeline is an automated workflow that handles everything from data collection and inference model training to deployment/monitoring.
- ML ingest data from the network to learn patterns and make predictions.



PROBLEM

- Increase in data consuming slows the network.
- Utilization spikes, can compromise network QoS.
- Technical problems (latency, packet loss) cause data transmission delays.
- Simply setting up more network and maintaining it is expensive.





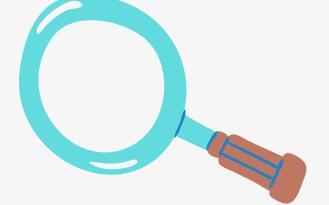
Combining Network Data Analytics Function and Machine Learning for Abnormal Traffic Detection in Beyond 5G

Abdelkader Mekrache

Karim Boutiba

Adlen Ksentini

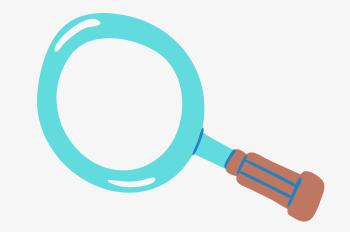
In this research, NWDAF was developed to enable subscription and analytical services. Machine learning was employed to detect abnormal traffic patterns and potential DDoS attacks. However, limitations include reliance synthetic testing, the risk of false positives, sensitivity traffic pattern shifts, necessitating frequent model retraining.



A Smart Data Analytics System Generating for 5G N/W System Via ML Based Algorithms for the Better Communications

Nisha Dr. Lakshman K Dr. Raj Kumar

This study uses three ML models, <u>Linear Regression</u>, <u>Recurrent Neural Networks</u> and <u>Long Short-Term Memory</u> to address network load effectiveness. The authors conclude that neural networks perform better in network load prediction than linear regression.



Demo: Enhancing Network Performance based on 5G Network Function and Slice Load Analysis

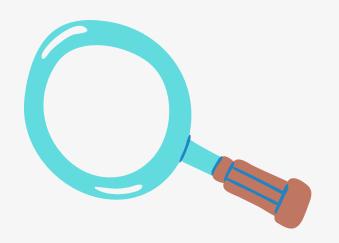
Rui Ferreira Duarte Joao Fonseca Marco Araujo

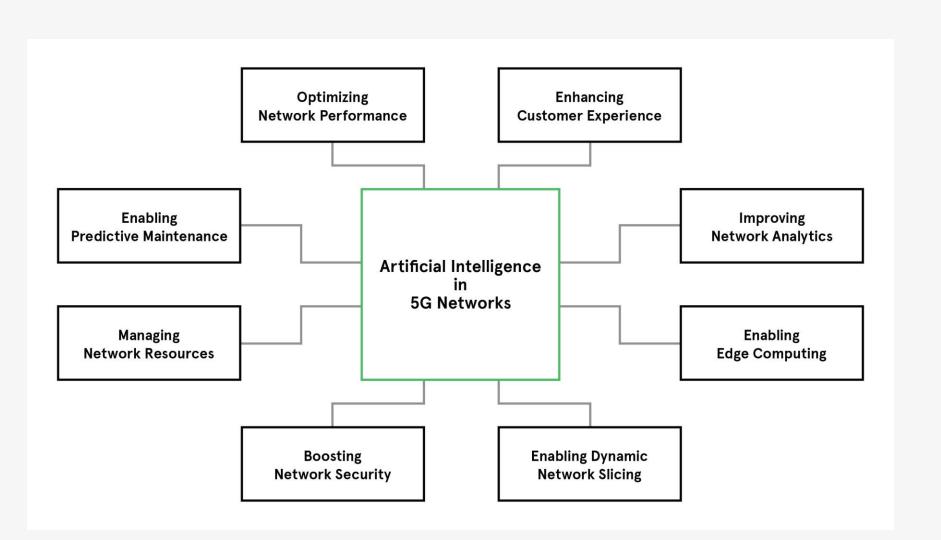
Joao Silva Raul Barbosa Mayuri Tendulkar Bruno Mendes Adria

Paulo Adriano Goes

This paper addresses the importance of monitoring and gathering network metrics in real-time to predict network function load. The authors emphasize for the constant retraining of the model, as it became biased in short term, retraining would allow the model to better adapt to dynamic traffic patterns.

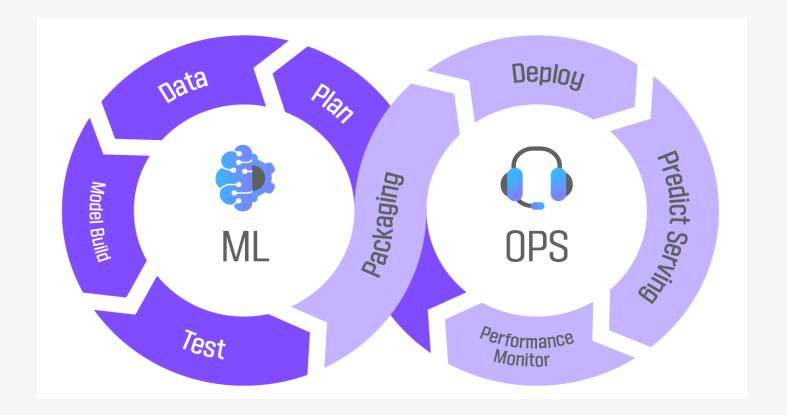
- Like previous works, our project aims to make future generation networks more adaptive and intelligent.
- Other researchers concluded that the ML model choice is critical.
- The optimal selection depends on the specific use cases implemented and the necessity for retraining.
- We intend to go even further and develop and integrate a MLOps pipeline within the NWDAF-like architecture.

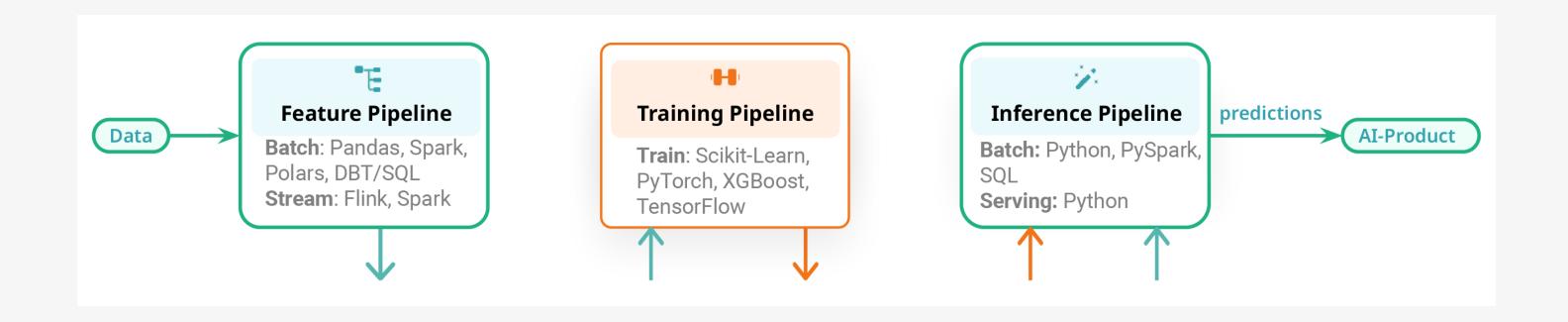




GOALS

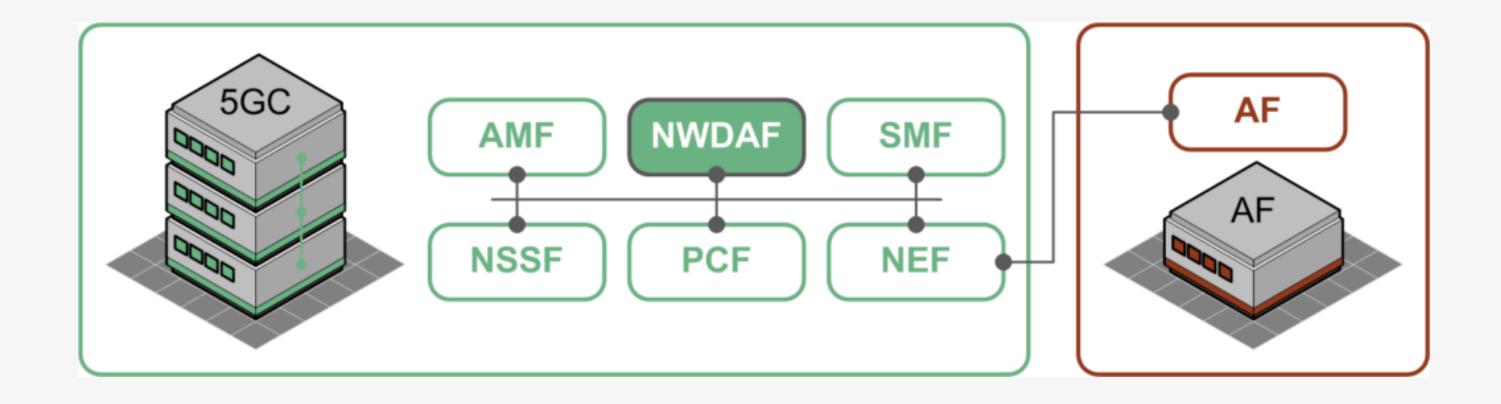
- Implement a Data Pipeline for Network Intelligence.
- Develop and Integrate Machine Learning Models.
- Automate Network Optimization & Decision-Making.





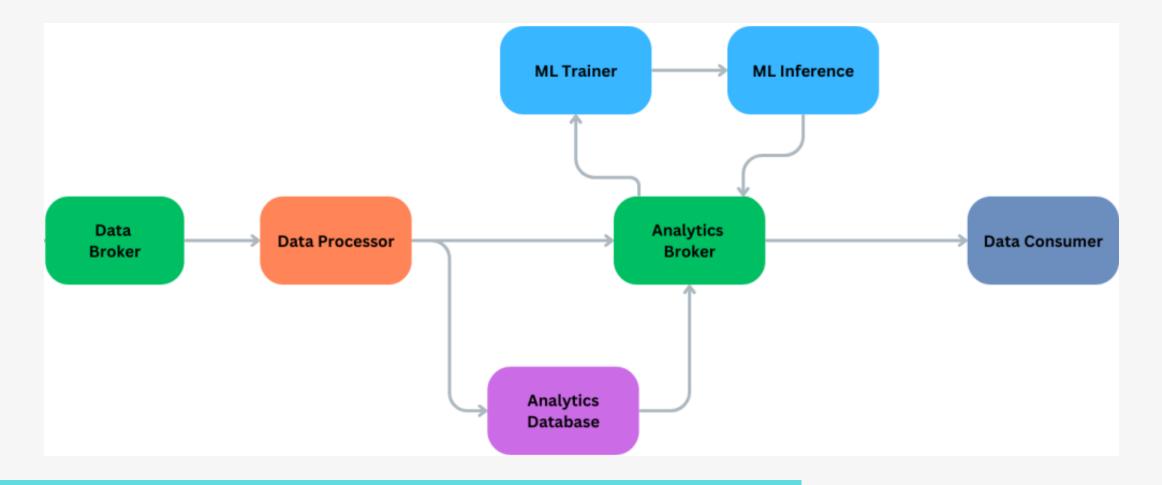
GOALS

- Implementation of a scalable and modular MLOps pipeline that works as a NWDAF when integrated with a 5G network.
- Ensure Compliance with 3GPP Standards.
- Attempt Integration with existing 5G Core Network Components.



GOALS

- Ensure seamless Communication Between Services within the pipeline.
- Evaluate System Performance under several Network Conditions.
- Provide a User-Friendly Deployment and Monitoring System.



EXPECTED RESULTS

- A modular and scalable MLOps pipeline that when integrated with a 5G network works as a base for a NWDAF.
- A NWDAF-like architecture that can be deployed in any 3GPP-compliant network.
- Comprehensive validation of NWDAF-like architecture performance through real-world use cases in a 5G environment.



Communication Plan



Slack - Communicate with tutors.



Github - Coding Repository



Discord - Team Communication



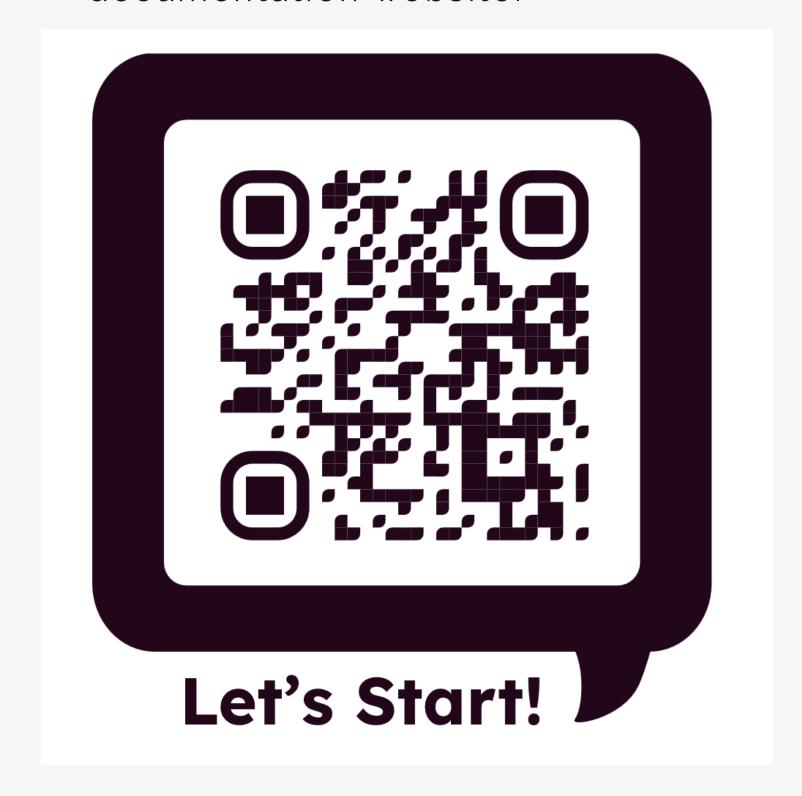
Github Projects – SCRUM to organize teamwork.

PROJECT CALENDAR

Click <u>here</u>, for a better view.

	Feb 10, 2025			Feb 17, 2025 Feb 2		Fab 24,	1025	Mar 3, 2025		Mar 10, 2025		Mar 17, 2025		Mar 24, 2025		Mar 3	1, 2025	Apr 7, 2025	Apr 7, 2025 Apr 14, 2		Apr 21, 2025		A	pr 28, 2025	May 5, 2025		May 12, 2025		May 19, 2025		May 26, 2025		Jun 2, 2025	
TASK ASSIGNED TO	10 11 12 M T W			18 19 20 21 T W T F	22 23 24 S S M	25 26 27 T W T	20 1 2 F S S	3 4 5 6 M T W T	7 8 9	10 11 M	12 13 14 15 16 17 W T F S S M	7 10 19 20 2	H 22 23 24	25 26 27	F S	30 31 1 2 S M T W	3 4 5 6 T F S S	7 8 9 10 11 12 M T W T F S	13 14 15 S M T	16 17 18 11 W T F S	9 20 21 22 S S M T	23 24 25 26 W T F S	6 27 28 29 5 S M T	30 1 2 3 W T F 3	3 4 5 6 7 8 9 1 5 5 M T W T F	10 11 12 S S M	13 14 15 16 T W T F	7 10 19 20 S S M T	21 22 23 24 W T F S	25 26 27 S M T	20 29 30 31 W T F S	1 2 3 4 S M T 1	5 6 7	0 S
Deliverables																																		П
Microsite creation and mainter Rodrigo, Jorge																																		П
Project plan (Use cases, Scer Hugo, Eduardo, João																																		
Principal Requirements Elicita Everyone																																		
M1 - Inception Everyone																																		
Architecture Definition Rodrigo, Eduardo																																		
State of Art João, Jorge		Ш																																Ш
M2 - Elaboration Everyone		Ш																																Ш
Prototype Hugo, Eduardo, João		Ш																																Ш
M3 Everyone		Ш																																Ш
Demo Preparation João																																		
Poster Everyone																																		
Technical Report Everyone																																		
M4 Everyone																																		
Detailed Requirements Elicits Everyone																																		
Data Handler																																		
Data gathering method Rodrigo, Eduardo																																		Ш
Data processing method João, Hugo																																		Ш
ML Datasets Rodrigo, Eduardo																																		Ш
Data Ingestion Hugo, João																										Ш								Ш
Statistical Analysis Hugo, Rodrigo		Ш																																Ш
Detailed DH requirements elic Everyone		Ш																								\perp								Ш
Data Monitoring		Ш																																Ш
Monitoring interface Jorge, João, Hugo		Ш																																Ш
ML performance and statistics Jorge, Hugo		Ш																																Ш
Monitoring requirements elicit: Jorge, Hugo		Ш						Ш		Ш																Ш						$\perp \perp \perp$		Ш
ML Ops Pipeline		Ш						Ш		Ш																						$\perp \perp \perp$		Ш
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ML Training Rodrigo, João, Hugo, Eduardo		Ш																																Ш
ML Deployment Eduardo, Rodrigo		Ш																																Ш
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5G Core Integration		Ш								Ш																					$\perp \downarrow \downarrow \downarrow \downarrow$	Ш		Ц
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5G network integration Everyone		Ш								Ш						$\perp \perp \perp \perp$															$\perp \! \! \perp \! \! \perp \! \! \perp$	Ш		Ц
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Global Requirements Review Everyone																																		

Scan the QR code to check our documentation website.



Or click <u>here</u>.

THANK YOU