Work and Projects

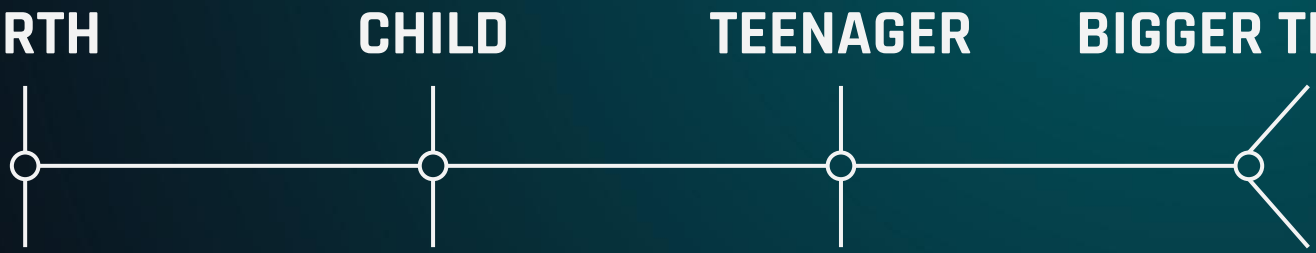
Overview

Pierre Lague - PhD Candidate

WHOAMI

- **Pierre Lague**, 23 years old.
- Currently enrolled in a Machine Learning M. Sc. at the University of Lille.
- Machine Learning Engineer Apprentice at Sudo Group.
- Applying for a PhD in the field of Multi-Agent and distributed systems with a key-note in reinforcement learning (and MARL).
- PhD position in Coordination of Heterogeneous Multi-robot systems for Multi-objective Missions

Early Education



2001-2003
Schooled in Rennes, France and Cambridge UK

2011-2012
Ilam School, Christchurch, NZ

2014
Liberton School, Edinburgh, Scotland

2016-2019
Lycée Chateaubriand BAC S (spé Math), mention Bien, Rennes, France

University Studies

2019-2021

27th/47

IUT Informatique, Uni. of South Brittany.

2021-2022

1st/44

B. Sc. Data Science and Cs. Engineering, Uni. of South Brittany

2022-2023

2nd/6

M. Sc. Complex Systems Engineering, UTC

- Systems Dynamics
- Graph Theory
- Complex System Design

2023-2025

2nd/16

M. Sc. Machine Learning, Uni. of Lille

- RL
- MARL
- Multi-Agent Systems
- Graph Learning
- NLP (attention, transformers etc.)

Internships

🎓 Accenture Technology - 4 Months, 2021

“Road condition assessment using publicly available data, on-board sensor apps and Machine Learning”

- Use of Python and DataIku
  - Sklearn unsupervised learning algorithms.
  - Extensive data collection and data processing pipeline.
  - Active participation in the team and presentations. The proof-of-concept made it to the dev team for a client.

- Autonomous research on model performance (metrics), model optimisation (hpo) and deployment pipelines.
- Theoretical and practical presentation of complex models (SVM, XGBoost).
- Apprenticeship offer that I declined at the end of the internship.

Internships

CNRS LETG Unit - 4 Months, 2022

“Semantic Segmentation State of The Art for Ultra High Resolution UAV Imagery.”

- Use of Python and Pytorch
  - Encoder-Decoder Semantic Segmentation architecture on Pytorch.
  - Jobs were sent on GPU clusters for training and inference.
  - ANR project, assisting a post-doc researcher.
  - Fully autonomous research on model architecture and metric development.

- Learned a lot about architectures such as U-Net and Semantic Segmentation in general.
- Had to lead a problem-shift from semantic seg. to object detection when we realised the approach was not right because of poorly labeled data.
- Extensive data preprocessing methods to adjust the ground truth and the captured images.

Internships

CNRS OSUR Unit - 1 Month, 2023

“3DMASC : Objective Evaluation on Benchmarked Urban Environment LiDAR Data”

- Use of CloudCompare and Python
  - LiDAR data manipulation and understanding.
  - Worked closely with a PhD Student (developer of the 3DMASC Algorithm).
  - Feature and benchmarked data engineering.
  - Autonomous research on how to improve the model performance on a new environment.

- Model achieved significant results on a benchmarked dataset.
- Proof that the novel lightweight, shallow learning method is as good as heavy deep learning method for LiDAR point cloud classification.
- Team and teachers satisfied with my work. I got the maximum grade for the internship.

Apprenticeship

Sudo Group - 1 year (2024-2025)

“Leverage Machine Learning to propose dynamic and adaptable virtual machine recommendation in the Azure environment.”

- Use of Python and Sklearn
  - Manipulate and process important amount of data on BigQuery via the Google Cloud infrastructure.
  - Develop full pipelines: load, process, train, infer, send to client (via terraform and cloud functions).
  - Fully autonomous on model development.
  - Problem that is completely new in the field of cloud optimization.

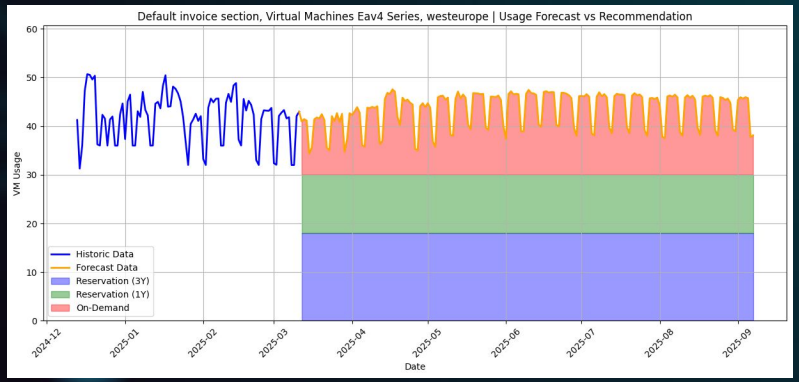
- Forecast cloud usage over 6 months using XGBoost.
- Extensive feature engineering to allow one general model to forecast multiple uses (flat lines or high fluctuations).
- Inter-team cooperation and research.
- Real-client meetings and presentation of developed features.
- Active research collaboration with Télécom Paris.
- Proposed a CIFRE PhD, but I declined.

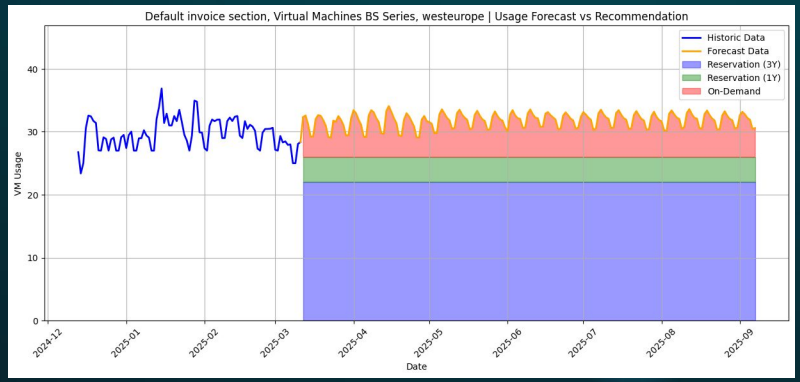
Apprenticeship

Sudo Group

Propose a dynamic recommendation of Reserved Instances on Azure for a 1y or 3y commitment to full use of a virtual machine. This forecast is based on 3 months of use and various time series feature engineering.

Adaptive and dynamic reservation recommendations for different VMs





Thesis and End of Year Assignment

Uni. Of Lille - 2 years

Thesis: “Load-balancing and Task Allocation in Dynamic Multi-Agent Systems”
EOY Assignment: “CBAAL - Consensus-Based Auction Algorithm Library”

- Both projects are linked and part of my aspiration to pursue my studies in the field of multi-agent learning and distributed systems.
- The CBAA algorithm is part of the methods I analyzed in my thesis.
- Both were supervised by Pr. Maxime Morge, now professor at Uni. Lyon 1.
- Exchange on the subject with Dr. Joseph Suarez @ PufferAI about multi-agent learning and certain algorithms.

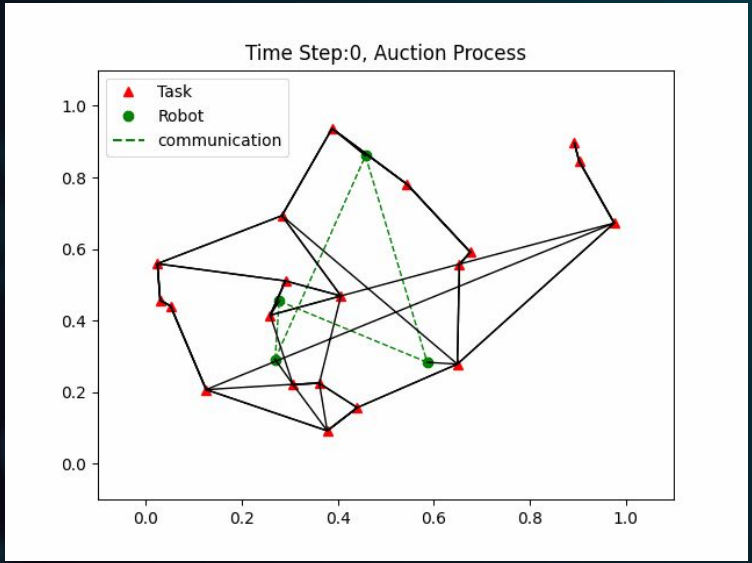
- Theoretical breakdown of each algorithm (centralized, decentralized, CTDE).
- Full analysis of results and interpretation/limitations of the methods.
- Discussion on methods and their flaws, exploration of how they could be solved (specifically the single point of failure issue and computing tractability).

End of Year Assignment

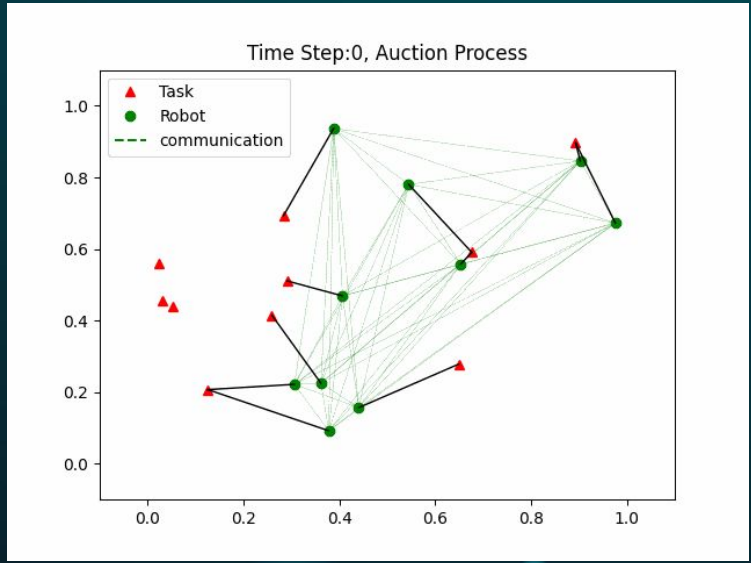
CBAAL

The algorithms implemented in this project are inspired by the publication of Choi et al., which introduced these innovative approaches to solving load balancing challenges in dynamic environments. Implemented in Python (available on my github).

CBBA - Multi task assignment simulation



CBAA - Single task assignment simulation



Interest in the PhD

The Subject

- The aim is to take the current SOTA consisting homogeneous teams performing single, relatively simple tasks **to a heterogeneous team with multi objective tasks via coordination mechanisms and later on reinforcement learning to enhance the adaptability of the agents.**

- The core enhancement comes by leveraging dynamic interaction models as seen in biological and social networks via means of communication allowing coordination (information sharing, spatial awareness, environment and teammates approximation, modelling via cooperative games ?)

    - NonLinear agreements: Consensus protocols (in direct link with my thesis and end of year assignment)
    - Opinion dynamics: Develop beliefs and maybe classes of agents in a backend system who would evolve towards a certain belief (neural MMO inspired)
    - Multi-Layer Graphs: to understand to which objective or teammate should an agent's "attention" should be brought (graph learning class very helpful on that matter)

- Using RL potentially to tune the parameters of the opinion dynamics models, learn interaction policies directly, or further enhance the system's adaptability and robustness to unforeseen dynamic conditions. (env wrappers, rl and marl knowledge, dynamic systems class)

Interest in the PhD

The Research

- Overall aim: create more intelligent, flexible, and robust heterogeneous multi-robot teams by equipping them with interaction mechanisms inspired by complex adaptive systems found in nature and society, bridging the gap between theoretical social dynamics models and applied robotics under realistic constraints.
    - Potential societal and environmental impact with such research on rescue missions, fire operations, and large scale task automation (farming, surveying without the need to specify mission priority).
    - Important in the defense sector with UAVs now working in swarms and needing coordination with centralized or decentralized brains.
    - Cutting-edge research on a growing and interesting subject.
    - Complex subject, research challenge and potential collaboration with some scientists I have in mind working at PufferAI, Helsing and Telecom Paris.

Interest in the PhD

The Team

- Academic research among brilliant researchers and renowned institute.
- Work on robot control and complex systems (Pr. Robuffo Giordano)
- Work on consensus, graph networks, and spatial awareness for robots (Dr. Restrepo)
- INRIA is the leading institute in the field of control systems and distributed AI in France, it is above all an honor and a great opportunity.

The skills

- Strong academic performance in Reinforcement Learning and Multi-Agent Systems.
- Strong python skills (pytorch, rllib, gym). Summer start a C++ ML training.
- Team-worker, cooperative but also independent, seeks to improve and learn.
- Highly adaptive to new techs and tools/frameworks (each internship was a different tool/data type etc.)
- Good academic performance overall.

HOWEVER : I have no experience in Matlab or Simulink and have little knowledge in robot modeling. But I am eager to learn and will prove myself very efficient with these new skills.

Thank you !

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