Project Overview

Electric Vehicle Routing Plan

Plan of 9 month period

# Project Description

This project explores the intersection of Deep Reinforcement Learning (DRL) and Graph Neural Networks (GNN) with a focus on the Electric Vehicle Routing Problem (EVRP). The core idea is to enhance the understanding of RL models, particularly when applied to GNNs, using Explainable AI (XAI) techniques. By applying XAI, we seek to demystify how these models make complex decisions and optimize solutions in the context of EVRP. A comparison study between different DRL models combined with GNN and XAI is envisioned.

XAI aims to reveal the decision-making process and the internal mechanics of these models, which are typically considered "black boxes." By applying XAI, we seek to demystify how these models make complex decisions and optimize solutions in the context of EVRP. A comparison study between different DRL models combined with GNN and XAI is envisioned.

# Objectives

1. Develop different models for electric vehicles using different technologies of DRL and GNN.
2. Integrate XAI to each model to enhance transparency, allowing to understand the routing decisions.
3. Provide a comparison study between different models to demonstrate results.

# Deliverables

1. Different fully trained and optimized DRL-GNN-XAI models for EV routing.
2. Comprehensive documentation
3. Research paper

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# Methodology: Agile

The Agile methodology is a project management approach that involves breaking the project into phases and emphasizes continuous collaboration and improvement. Teams follow a cycle of planning, executing, and evaluating. Traditional agile project management can be categorized into two frameworks: **scrum** and **kanban**.

## **1- Scrum**

uses fixed-length iterations of work, called sprints.

**Iterations/Sprints**:

* The project will be divided into different phases and for each phase divided into several 2-week sprints.
* Each sprint delivers an incremental, working piece of the solution.

**Project Backlog**:

* A prioritized list of tasks broken into **Epics and Tasks**.

**Ceremonies**:

* **Sprint Planning**: Define the sprint goal and backlog items for the sprint. For each sprint plan tasks are explained and each member chooses his tasks. Remaining tasks the team lead distributes them
* **Daily Standups**: 15-minute daily meetings to discuss progress, blockers, and plans.
* **Sprint Review**: Review the completed work for feedback.
* **Sprint Retrospective**: Reflect on the sprint to identify improvements for the next one.

**Tools: word document online**

## **2- Kanban**

For each task there is a cycle of To do, doing, and done.

**Tools: Trello board**

| Methodology Timeline | | |
| --- | --- | --- |
| No type Task | No type Description | Dates Time |
| **Sprint Planning** | Define the sprint goal and backlog items for the sprint. For each sprint plan tasks are explained and each member chooses his tasks. Remaining tasks the team lead distributes them | Every 2 weeks |
| **Daily Standups** | Message in group for progress | when needed |
| **Sprint Review** | Review the completed work for feedback. | Every 2 weeks |

| Project Timeline | | |
| --- | --- | --- |
|  | No type Description | Dates Date |
| Phase 1 | Project Initialization   1. Discuss different phases of the project 2. Discuss team roles and tasks | 26 Jan 2025 |
| Phase 2 | Literature review   1. What DRL models are mostly used 2. GNN models mostly used 3. Combination of both DRL GNN? 4. What metrics are commonly used | 9 Feb 2025 |
| Phase 3 | Data Preparation and Research   1. Define problem statement 2. Define system architecture. 3. Prepare dataset 4. Set up repositories, development environment, and CI/CD pipeline. | 16 Feb 2025 |
| Phase 4 | Model Development   1. DRL model dev 2. GNN integration 3. Train & Test performance 4. Document results | 2 Mar 2025 |
| Phase 5 | Explainability Integration | 16 Mar 2025 |
| Phase 6 | Performance Evaluation and Comparison | 23 Mar 2025 |
| Phase 7 | Optimization and Scalability Testing | 30 Mar 2025 |
| Phase 8 | Documentation and Paper Writing | Date |

Phase 1: Project Initialization

Phase 1: Project Initialization

1. **Management team**: coordination + planning
   1. Project management
   2. Strategic planner
2. **Dev team**: dev and implementation of models
   1. Team lead
   2. DRL GNN Engineer
   3. XAI Engineer

| Team Roles | | | |
| --- | --- | --- | --- |
| People Name | PeopleBackground | Drop-downs Role | No type Description |
| Dimeth [Dimeth Nouicer](mailto:dimethnoucer@gmail.com) | PhD in E-Mobility and RL | Management Team Project management | Coordinates the team, ensures timelines are met, and manages communication. |
| Elie [elie.mulamba5@gmail.com](mailto:elie.mulamba5@gmail.com) | PhD in ML and NLP | Management Team Strategic Planner (Architect) | Coordinate to define the problem statement, select technologies, and design the solution architecture. |
| Imen  [imen habibi](mailto:habibiimen454@gmail.com) | Undergraduate engineering | Development TeamXAI Engineer | Implements and optimizes machine learning models (DRL, GNN). |
| Jérémie [jeremie@aims.ac.za](mailto:jeremie@aims.ac.za) | Masters in AI  Masters in Maths | Development Team DRL GNN Engineer | * Implements and optimizes machine learning models (DRL, GNN). * Develops and implements **XAI** |
| Mame[mame.d.diouf@aims-senegal.org](mailto:mame.d.diouf@aims-senegal.org) | Masters in AI and operational research | Development TeamDevelopment Team Lead  XAI Engineer | * Reviews and integrates code contributions. * Tunes the models for performance and scalability. * Focuses on creating the **XAI features** |
| Souleymane [diallo.souleymane1@uam.edu.sn](mailto:diallo.souleymane1@uam.edu.sn) | Undergraduate engineering | Development TeamDRL GNN Engineer | Implements and optimizes machine learning models (DRL, GNN). |

| Phase 1 Timeline: Project Initialization and Research | | | | |
| --- | --- | --- | --- | --- |
| No type Task | No type Description | Dates Deadline | No type Assigned to | No type Output |
| Sprint details | Discuss sprint duration, meeting time | 26 Jan 2025 | Project management |  |
| Prepare tasks for each phase |  | 27 Jan 2025 | Management Team |  |
| Prepare commun space to share papers and progress |  | 28 Jan 2025 | Project management |  |
| EVRP GNN RL research | Study the latest literature & latest research | 9 Feb 2025 | Management Team  Development Team | Provide a resume on each read paper: problem statement, metrics, used methods/models, and results |
| Prepare Github repos |  |  | Management Team |  |
|  |  | Date |  |  |
|  |  | Date |  |  |
| EVRP problem design | Decide metrics, methods to be used, and problem statement | 16 Feb 2025 | Management TeamDevelopment Team Lead |  |

Phase 2: Research & development

Phase 2 Plan