Aim:

To solve the benchmark AI tasks provided by “Gymnasium” using model based RL control techniques including LQR and iLQR.

Further, we attempt to learn the model using a simple NN.

Objective:

Solve the following environments from Gymnasium:

1. Acrobot
2. Cart Pole
3. Moountain Car Continuos
4. Mountain Car
5. Pendulum

Using a model based RL control technique using iLQR. Model for these tasks are known.

Further we use a NN to try and learn the model and then use it in LQR. This is compared with the ideal model based control to study the cost of learning the model. We compare NN no. of layers, parameters needed to learn it sufficiently.

Timewise workplan:

1. Imple

**Project Proposal: Model-Based Reinforcement Learning for Benchmark AI Tasks**

**Aim**

This project aims to solve benchmark AI control tasks from the *Gymnasium* environment using model-based reinforcement learning (RL) techniques, specifically *Linear Quadratic Regulator (LQR)* and *Iterative Linear Quadratic Regulator (iLQR)*.

Additionally, we attempt to learn the system dynamics (model) using a simple neural network (NN) and analyze its effectiveness in model-based control.

**Objectives**

1. Implement model-based RL control using iLQR for the following *Gymnasium* environments:
   * Acrobot
   * CartPole
   * MountainCarContinuous
   * MountainCar
   * Pendulum

Since the mathematical models for these tasks are known, we will first use the ideal system model for control.

1. Train a neural network to learn the system dynamics from data. The learned model will then be used within the LQR framework to assess its performance.
2. Compare the performance of NN-based learned models with the ideal system models, evaluating the trade-off between model accuracy and control effectiveness.
3. Analyse the impact of NN architecture (e.g., number of layers, parameters) on the quality of the learned model and its effectiveness in control.

**Work Plan and Timeline**

**Proposal Submission (February 7)**

* Finalize project scope, objectives, and methodology.

**Checkpoint 1 (March 7) – Model-Based Control Implementation**

* Set up Gymnasium environments and implement iLQR for selected tasks.
* Evaluate control performance using known system models.

**Checkpoint 2 (March 28) – Learning-Based Control**

* Train a neural network to learn system dynamics from data.
* Integrate the learned model into LQR to solve selected tasks.

**Final Presentation (April 14) – Comparative Analysis & Results**

* Compare and analyse learnt and ideal model-based control.
* Finalize results, prepare documentation, and present findings.