**Autonomous Lunar Landing**

Course: Reinforcement Learning

**Project Objective**

The goal of this project is to train an autonomous agent using Reinforcement Learning (RL) to land a spacecraft safely on the Moon in the **OpenAI Gym Lunar Lander** environment. The agent must learn to stabilize the lander, minimize fuel consumption, and land smoothly while dealing with gravity, inertia, and dynamic uncertainties.

**Motivation for Choosing Lunar Lander**

**Complex problem**: The agent must optimize multiple constraints (fuel efficiency, stability, and precision) in a complex, partially observable environment.

**Strong foundation for RL applications**: The project offers an opportunity to apply key RL concepts such as policy learning, reward shaping, and exploration-exploitation tradeoffs.

**Implemented RL Agents**

I plan to implement and compare different RL algorithms:

* **DQN** (Deep Q-Network): Discrete action control with experience replay.
* **PPO** (Proximal Policy Optimization): Policy gradient method for better stability.
* **SAC** (Soft Actor-Critic) [if time permits]: Handles continuous action spaces efficiently.

**Expected Results & Challenges**

**Expected Outcomes:**

* A trained RL agent capable of landing safely with a high success rate.
* Performance comparison of DQN vs PPO vs SAC (learning speed, stability, final reward).
* Graphs and visualizations of training curves, landing attempts, and agent improvements.

**Challenges:**

* Exploration vs Exploitation: The agent must balance random actions with optimizing learned strategies.
* Reward Shaping: Proper tuning of the reward function is crucial for efficient learning.

**Conclusion**

This project will demonstrate the power of Deep RL for autonomous spacecraft landing. The results could be extended to drone landings, robotic control, or real-world aerospace applications.