MACHINE LEARNING / REINFORCEMENT LEARNING

1. **"Traversing the Warehouse: A RL affair" [10]**
   Again, as an employee of a big warehouse, you have built a robot to navigate through the dynamically changing environment of the warehouse. You have the robot that you get from the company one with a LIDAR(gives a distance map of the objects in the scene) and an RGB-D(gives an RGB image) camera. Now it's ready to go! or is it? Now you encounter the issue of driving the robot autonomously through the constantly changing environment of the warehouse. Because of this one can't just save a map of the warehouse to calculate all its movements.
   You must build a reinforcement learning problem. To achieve the desired goal, you need to formulate a Reinforcement Learning problem that uses the system given to you. To make navigation work with Reinforcement Learning, define the agent's state space with state variables from sensor data, create a suitable reward function, and specify the available actions and their representation in the environment.
2. **"Energy Optimization"[15]**
   Consider a robot that moves in only one dimension (say, along the x-axis) and consumes energy according to the equation,

$$P = \alpha v^2 + \beta|x|, \text{ where } \alpha = 1\ Ns^2/m \text{ and } \beta = 2\ N$$

Given two points $a > 0$ and $b > 0$ as the starting and ending points of the robot, we are interested in finding the optimal velocity that the robot should move with, to minimize the overall energy consumption. Note that this velocity may be a function of time/position.

Your teammate Sajal suggests solving this problem by modelling it into a gradient descent problem. Write a model for the same.

Here's a hint to proceed:

Divide the total time/distance into n equal intervals and approximate the motion with constant velocities in these intervals. Then try finding the optimal velocity profile for all these intervals by letting P_i be the energy consumption rate during the i^{th} time step. You may or may not assume that you already know the total time T or total distance D. Marks will be given based on this approach.

NOTE: Clearly mention the cost function you are optimizing, the involved parameters (mentioning which of these are fixed, and which will get learned), and the gradient of the cost function.