In this assignment you solve a problem regarding MDP. You need to formulate the mathematical model and solve it with Python and Gurobi.

Problem

A student is concerned about her car and does not like dents. When she drives to school, she has a choice of parking it on the street in one space, parking it on the street and taking up two spaces, or parking in the lot. If she parks on the street in one space, her car gets dented with probability 0.1. If she parks on the street and takes two spaces, the probability of a dent is 0.02 and the probability of a $15 ticket is 0.3. Parking in a lot costs $5, but the car will not get dented. If her car gets dented, she can have it repaired, in which case it is out of commission for 1 day and costs her $50 in fees and cab fares. She can also drive her car dented, but she feels that the resulting loss of value and pride is equivalent to a cost of $9 per school day. She wishes to determine the optimal policy for where to park and whether to repair the car when dented in order to minimize her (long-run) expected average cost per school day.

1. Draw the State Transition Diagram for MDP, formulate an Average Reward MDP as LP and then solve it using Python and Gurobi.
2. Formulate the Bellman equations for Discounted Reward MDP (discount factor is 0.9), perform value iteration with Python (100 iterations to converge) and report the optimal policy and value. Note that the solution to Problem 2 is NOT necessarily the same as Problem 1.

Instructions

Submit a PDF file describing a MDP model and a solution to the problem instance. Also, submit a program (a Python script or a Jupyter notebook) using Gurobi to solve the problem instance (if needed). For the problem instance, report the values of the objective and decision variables.