Assignment-2: Cleaning up using search

**Deadline**: Wednesday 12 July, 2017 in Class

**Objective**: Design an AI for room cleaning

**Description of the Robot:**

An electric robot that can move left or right only using its electric battery. The robot can suck the dirt in the room it is currently in. Its battery capacity is 6 units. It can charge its battery by exactly one unit in a unit time step if it is connected to a battery charger and not doing anything else (i.e., moving or vacuuming). The robot's maximum battery capacity is 4 units and it cannot be charged beyond that. The robot can be charged irrespective of its current battery level but the minimum charging time is 1 time step. The robot can perform only one action at a time. Every movement of the robot requires 1 unit of electricity whereas performing suck requires 2 units. If the battery reaches 0 then the robot dies. The robot knows its location in the environment, i.e., it knows what room it is in.

**Environment:**

A building with three rooms named Left (L), Middle (M) and Right (R). The left room is connected to the middle room which is connected to the right room and there is no way to move from L to R or vice-versa without having to going through M. Every room can be either dirty (D) or clean (C). A dirty room can be cleaned by vacuuming. Only Room L has a charging station for the robot and the charging station has infinite capacity, i.e., it can keep on charging for as long as required. If the robot tries to move left in room L it stays in L. If it tries to move right in room R, it stays in R. If the robot executes "Suck" in a clean room, the room remains clean.

**Goal:**

Keep all rooms clean in minimum time.

**Starting State:**

Any state can be the initial state. The robot begins with a full charge.

**Required:**

Find a solution that reaches the goal from the initial state. As a test case, you can start off in room L with full battery with all three rooms dirty.

**Steps required:**

Use the pseudo-code of the goal-based agent in the slides or the AIMA book to guide you. Please choose a state representation and write the path cost and successor functions for all possible states. Construct the search tree.

**Questions:**

1. Will the robot always be able to clean all rooms? Why or why not?

2. Will the robot always be able to clean all rooms if we require that the robot end up in room L after cleaning up? Why or Why not?

3. What is the minimum battery capacity for the robot to be able to clean all rooms in the above two cases? Alternatively, by what minimum factor should the robot be made more power-efficient if it were to solve this problem?

4. Can you design an algorithm that cleans up the room with minimum battery power consumption?

5. What is the optimal place to put the charging station? Why?

**Submission requirements:**

A PDF (made using MS word/LaTeX) report describing your modeling of the state, path cost, successor functions, search tree and answers to all questions. Clear, neat and clean hand-drawn scanned images are acceptable. You will be asked to present your solution and reasoning in 5 minutes in the class.

**BONUS: Make a Python Simulation of your solution.**