Programming Assignment 3

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I. Task 1

In this task, we need to navigate the car out of square grid to the road. We are provided with the center of the road, the coordinates of car, it's velocity and the angle (θ) at every time step "t". At every time step, the car can rotate itself with $-3°, 0°$ and $3°$. Similarly, the possible values of acceleration are $-5, -3.95, 0, 3.95$ and 5 respectively. Here, the "-ve" sign indicates deceleration.
To solve this problem, we first calculate the angle θ' between the initial state of the car and the final point where it has to reach. Further, the car is rotated with no acceleration until the difference between the calculated range until the difference between angle of car and the calculated angle is less than the threshold k i.e $\mid \theta' - \theta \mid \leq k$. The algorithm of the same can be seen in Algorithm 1.

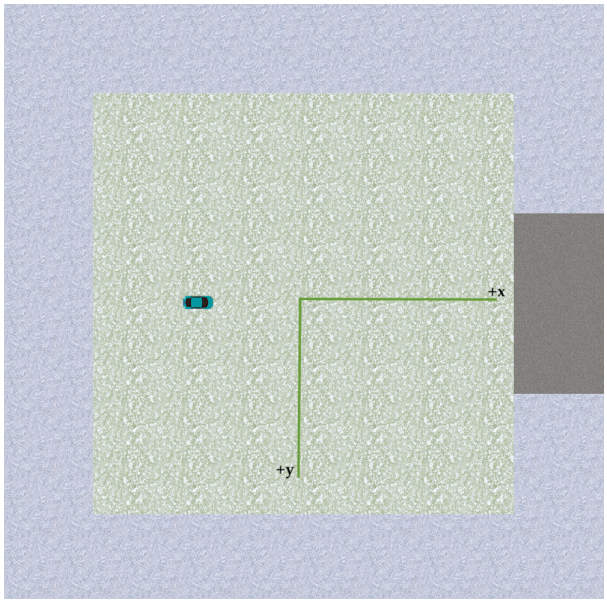

Figure 1: Task 1 [a]

Algorithm 1 : Task 1

```
Start
Get initial coordinates of car
Calculate angle (θ′) between initial state and the final state wherein car need's to reach
for all time steps do
    Get angle (θ)from state vector
    if | θ′ − θ |≤ k then
        Set steering = 1 and acceleration = 1 i.e no steering and maximum acceleration
    else
        Set steering = 2 and acceleration = 2 i.e rotate with no acceleration
    end if
end for
Stop
```

[a] https://www.cse.iitb.ac.in/ shivaram/teaching/cs747-a2022/pa-3/programming-assignment-3.html

II. Task 2

This task is similar to task 1 with the addition of 4 pits (one present in every quadrant). Whenever the car crashes on one of these pits, the task comes to an end. Hence, here we need to design an algorithm which not only has to reach the parking but also needs to avoid the pits. In this task, we have also been provided with some additional information i.e center of pits. We further calculate the size of pits by running the car in horizontal and vertical lines multiple times and printing it's coordinates. We also define an additional variable named "Flag" and set it to "True" so as to reduce the time complexity. Having collected all these information, we first check if the car lies in the region (Region 1) wherein there are no chances of it crashing with the pit, provided it goes at angle close to $0°$. If so we use the same algorithm as implemented in Task 1 i.e Algorithm 1. If not we check whether the car lies above or below the pit (Region 2). To check this, we make use of additional information of pit i.e height and width as calculated by doing some experimentation. If so than we move the accelerate the car after it's angle coming close to $0\circ$. This acceleration is applied if the car lies in this particular region. At any time "t" if it crosses the region the dynamics of action are change according to what we do in the next region which has been discussed further. In all the other parts (Region 3) i.e excluding Region 1 and Region 2, we rotate the car until it's angle is close to $90°$. Once it is, the car is accelerated until it reaches Region 1 after which it follows the corresponding actions. The algorithm which we follow in this task in given in Algorithm 2

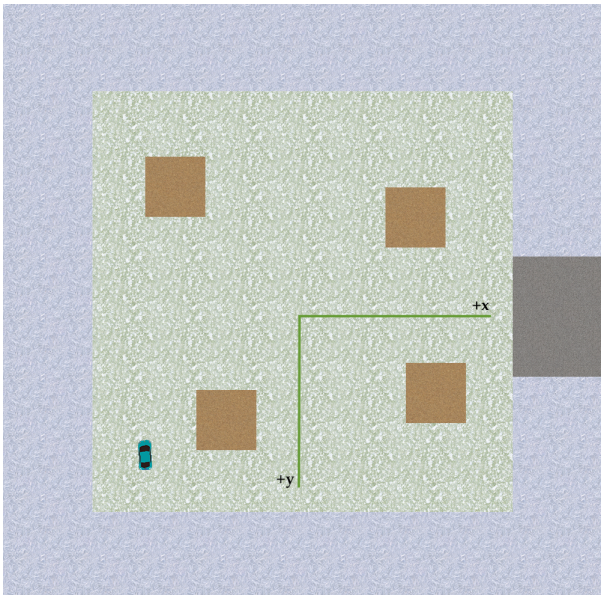

Figure 2: Task 2 [b]

[b] https://www.cse.iitb.ac.in/ shivaram/teaching/cs747-a2022/pa-3/programming-assignment-3.html

Algorithm 2 : Task 2

Start
Initialize Flag = True
for All time steps t **do**
    Get coordinates
    if y coordinate is between some threshold **then**
        if Flag is True **then**
            Calculate θ' and θ as done in Algorithm 1
        end if
        Follow actions as followed in Algorithm 1
        Make Flag = False if car is accelerating, otherwise make it True
    else
        Make Flag = True
        if y coordinate is less than 0 **then**
            if Car lies in region 2 i.e above or below pit with some negative and positive offset **then**
                Move car towards right by following Algorithm 1 by changing θ' to 0
            else
                Move car downwards by following Algorithm 1 by changing θ' to 90
            end if
        else
            if Car lies in region 2 i.e above or below pit with some negative and positive offset **then**
                Move car towards right by following Algorithm 1 by changing θ' to 0
            else
                Move car upwards by following Algorithm 1 by changing θ' to 270
            end if
        end if
    end if
end for
End