山东大学

崇新学堂

2022－2023 学年第一学期

实 验 报 告

课程名称：EECS

实验名称：

专 业 班 级 崇新 21

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实 验 时 间

Step1

To run a brain in the simulator.

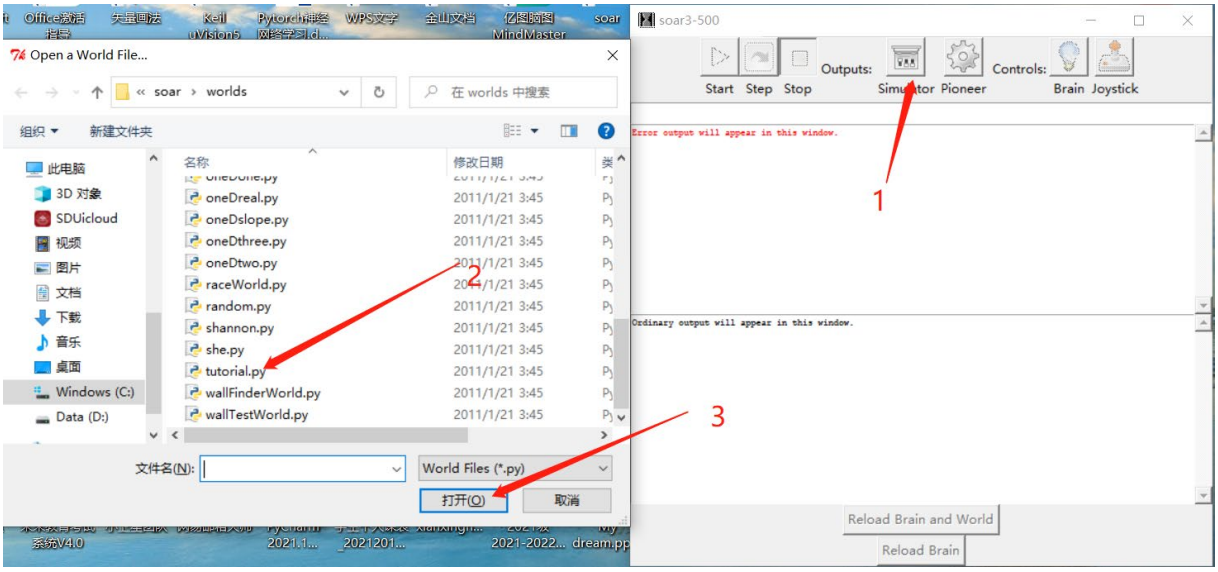


图 1 Load the world

Now we've loaded the world

Modify the brain and run it.

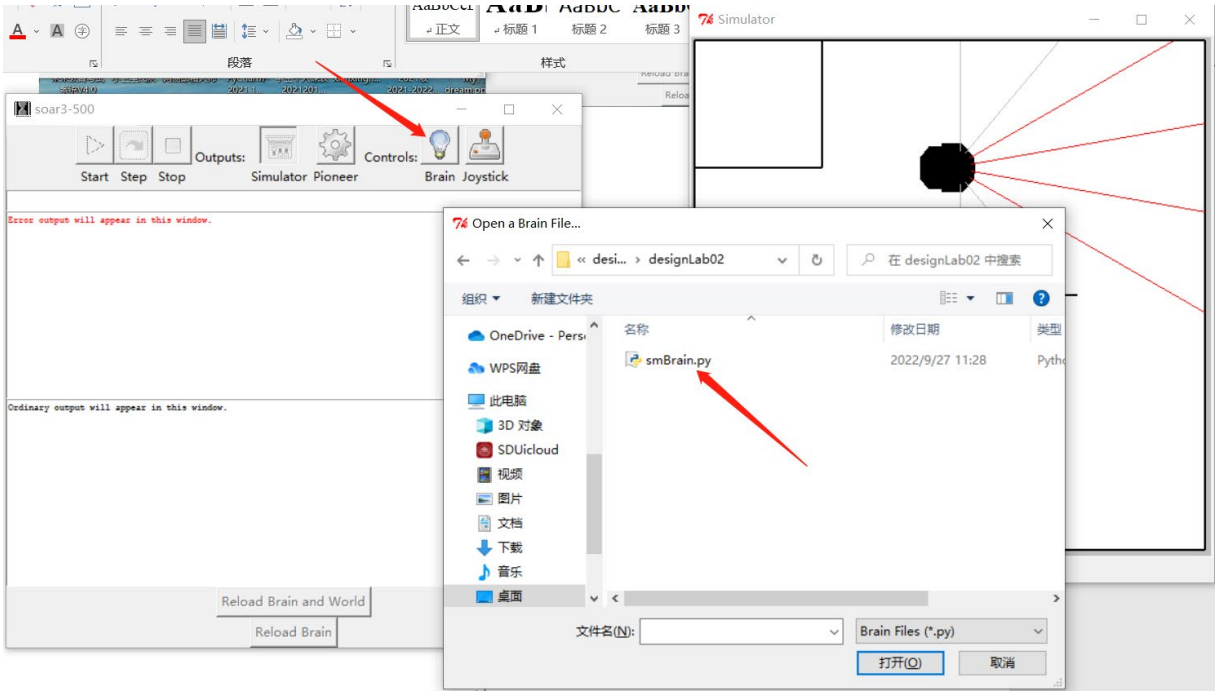


图 2 Load the brain

So now we've loaded the brain

Run it on the robot

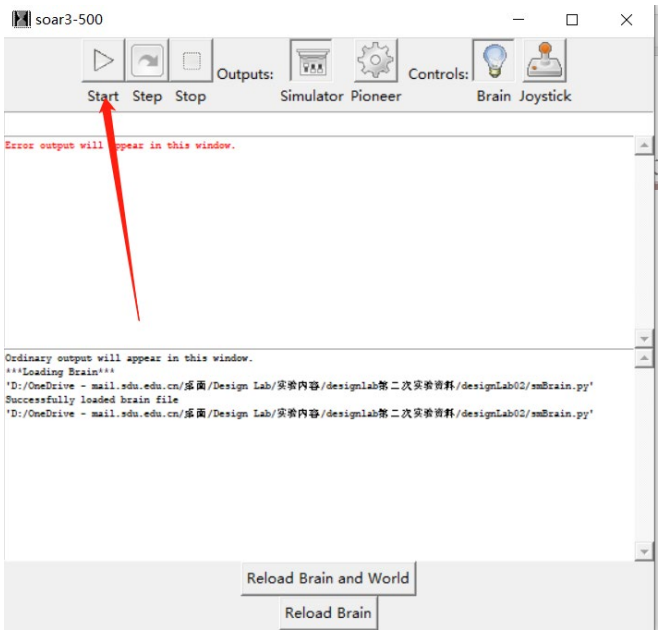


图 3 Run the robot

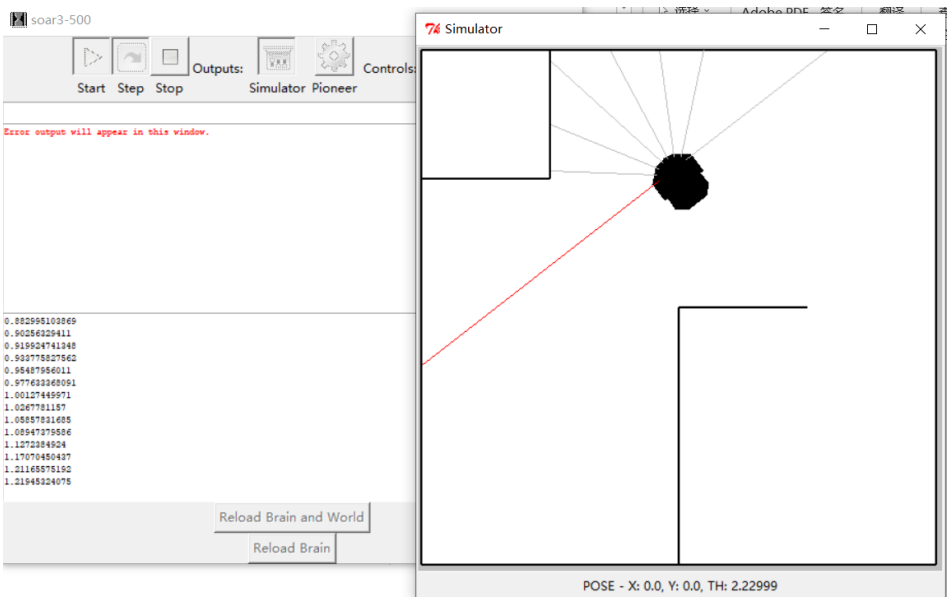


图 4 The reslut

Investigate the behavior of the sonar sensors

First set the speed of the car to 0.

```
class MySMClass(sm.SM):
    def getNextValues(self, state, inp):
        return (state, io.Action(fvel = 0, rvel = 0))
```

图 5 Modify the speed

```
    # set robot's behavior
    robot.behavior = mySM

# this function is called when the start button is pushed
def brainStart():
    robot.behavior.start(traceTasks = robot.gfx.tasks())

# this function is called 10 times per second
def step():
    inp = io.SensorInput()
    print inp.sonars[3]
    robot.behavior.step(inp).execute()
    io.done(robot.behavior.isDone())

# called when the stop button is pushed
def brainStop():
    pass
```

The value here can be any value from 0 to 8, which represents the value of the corresponding sonar output

Ln: 39 Col: 23

图 6 Print sonar

The first reading in the list (index 0) is from the leftmost (from the robot's perspective) sensor; the reading from the rightmost sensor is the last one (index 7).

Now let's look at the results

When very far away from the obstacle, the sonar output is 5.

```
5
5
5
5
5
5
5
5
5
5
5
5
5
```

图 7 Test sonar

When approaching the obstacle gradually, the sonar output value will become smaller.

```
1.47261237153
1.47323567771
1.48378848101
1.48537190897
1.47127353755
1.46789806661
1.46735751322
1.47459608814
1.47298695702
1.47928564826
1.47154652419
1.46812808006
1.46609280835
1.4673132569
```

图 8 Test sonar

```
1.2050488956
1.20398572949
1.20196430191
1.20518309477
1.20636209312
1.20525982103
1.20167590451
1.20595447315
1.20775495251
1.20699473243
1.20267892638
1.20313529839
1.2072592181
1.20535109649
```

图 9 Test sonar

```
0.901967853927
0.903431618834
0.903862934523
0.903393428701
0.904486874138
0.903897701706
0.90403394562
0.902824143255
0.902313741534
0.902127041742
0.902798512022
0.902655060938
0.90457654295
0.906412506942
```

图 10 Test sonar

```
0.140132951954
0.140121676064
0.140127868196
0.140127745441
0.140120741092
0.140139481463
0.140135411119
0.140122054986
0.140129813404
0.140133092538
0.140139542257
0.140125272367
0.14013194414
0.140132445505
```

图 11 Test sonar

Checkoff 1. Explain your strategy for implementing this behavior and your answers to the questions above to a staff member.

The sonar output value varies with the distance, the farther the distance, the larger the value. But the sonar will fail at too long a distance, keeping exporting 5. The maximum sonar range is 1.5.

Step2

Make the robot move forward to approximately 0.5 meters of an obstacle in front of it and keep it at that distance, even if the obstacle moves back and forth.

Let's add another criterion

```
class MySMClass(sm.SM):
    def getNextValues(self, state, inp):
        if inp.sonars[4]<0.5 and  inp.sonars[3]<0.5 and  inp.sonars[3]>0.3 and inp.sonars[4]>0.3:
            return (state,io.Action(fvel = 0,rvel = 0))
        else:
            return (state,io.Action(fvel = 0.3,rvel = 0))
```

图 12 add another criterion

We know that inp.sonars[3] and inp.sonars[4] are the two sonars straight ahead. When the values of these two sonars are greater than 0.3 and less than 0.5,then return velocity is 0.

Checkoff 2. Demonstrate your distance-keeping brain on a real robot to a staff member.

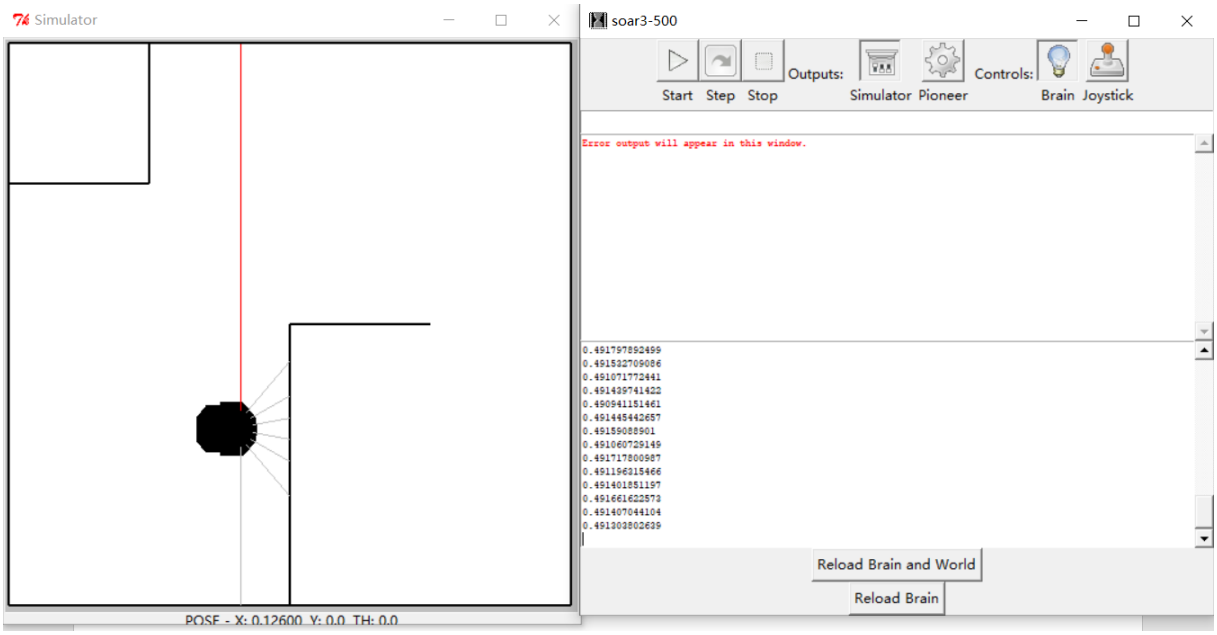


图 13Checkoff2

We can see that the distance between the car and the obstacle remains 0.3-0.5

Step3

To realize when there is nothing nearby , it should move straight forward, we make if in our code. On top of that we use a state machine. There are three states:'go_straight','near','corner'.

- Where 'go_straight' stands for straight ahead without obstacles
- Where 'near' stands for straight near the obstacles
- Where 'corner' stands for very close to obstacles

In addition, in order to make the car automatically judge the right and left turn, we also added another decision. We used another state machine 'further_state'. Then to Then let the car judge after entering the other two states:'turn_right' and 'turn_left'.

```
    if inp.sonars[0]+inp.sonars[1]+inp.sonars[2]+inp.sonars[3]<inp.sonars[4]+inp.sonars[5]+inp.sonars[6]+inp.sonars[7]:#在左墙边
        furtherState='turn_right'
    else:#在右墙边
        furtherState='turn_left'
#此处上下部分可以合并省去一个判断，为了好看才分开写的
    if furtherState=='turn_right':
        if (inp.sonars[0]<0.4 or inp.sonars[1]<0.4) and  inp.sonars[1] < 0.5:
            return ('near', io.Action(fvel=-0.08, rvel=-0.5))
        elif (inp.sonars[0]<0.4 or inp.sonars[1]<0.4) and  inp.sonars[1] > 0.5:
                return ('near', io.Action(fvel=0.08, rvel=-0.3))
        else:
            return ('near',io.Action(fvel = 0.1,rvel = 0))
    elif furtherState=='turn_left':
        if (inp.sonars[6] < 0.4 or inp.sonars[7] < 0.4) and inp.sonars[6] < 0.5:
            return ('near', io.Action(fvel=-0.08, rvel=0.5))
        elif (inp.sonars[6] < 0.4 or inp.sonars[7] < 0.4) and inp.sonars[6] > 0.5:
            return ('near', io.Action(fvel=0.08, rvel=0.3))
        else:
            return ('near',io.Action(fvel = 0.1,rvel = 0))
```

图 14 judgement condition

Summary

1、首先是一开始考虑不周，设计的只能右转，那么在有些靠近右墙的情况下，需要倒车等花费时间较长，于是我们加入了判断左右转的条件，使用的是左边 soar 得到的值和右边 soar 得到的值相比，看哪个大哪个小，进而再看朝哪个方向转向。

2、解决了左右转，但是此时出现会在某些地方撞墙，于是考虑到了条件的冲突问题。实验中判断在墙边的条件，以及考虑在墙角的情况和判断左右转的条件冲突问题为了解决问题，我们调整了 soar 的参数

3、然后出现的是距离的问题，按照讲义来说，离墙应该为 0.3-0.5，但是按照我们的判定条件，输出的 soar 值都在 0.2 附近，所以我们为了保持这个距离，加入了离墙近(<0.3)的时候加一个后退的速度，在符合题目要求的时候就不后退了，这时距离保持在 0.4

4、内外角转弯的问题：在下边那个尖的角处转弯的时候，最开始会撞墙，是由于我们的倒车条件不够严格导致。

5、如右图 15 所示，在这转弯的时候角度过大，直接向这个角冲过去，并且撞墙，将 go_straight 增加了原来是取 soar3、4 的平均值，修改为 3，4 均需要判定，同时修改 corner 的判定条件 inp.sonars[3]<0.15 , inp.sonars[4]<0.15，转弯后变成直行，并且距离 0.4

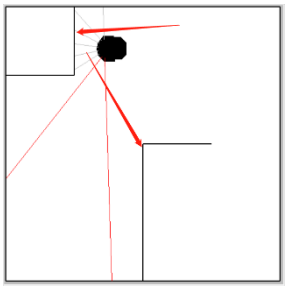


图 15

6、如右图 16 所示，在此处时，会出现 bug，因为最开始我们判断 near 只用了一个 soar，此处 soar[0]在 0 和 5 之间来回跳，因而出现 bug，所以我们加了(inp.sonars[0]<0.4 or inp.sonars[1]<0.4)这个用 or 来解决这个问题

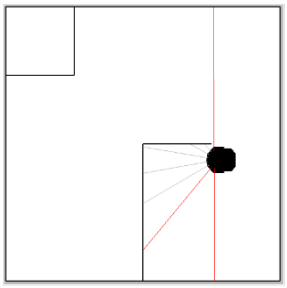
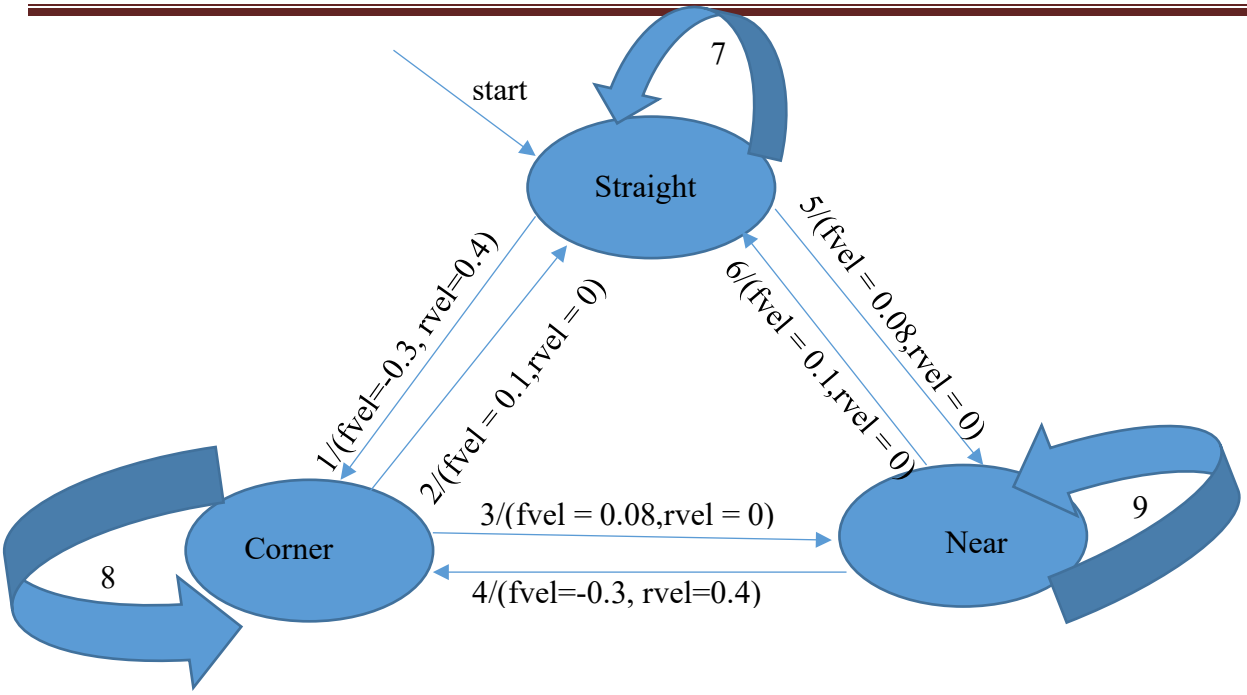


图 16



1) (inp.sonars[2] < 0.25 and inp.sonars[5] < 0.25) or inp.sonars[3]<0.15 or inp.sonars[4]<0.15 or (inp.sonars[3] < 0.2 and inp.sonars[4] < 0.2) or inp.sonars[2] + inp.sonars[3] + inp.sonars[4] + inp.sonars[6] < 0.75)
2) inp.sonars[3]>0.5 and inp.sonars[4]>0.5 and inp.sonars[0]>0.5 and inp.sonars[7]>0.5
3) else
4) (inp.sonars[2] < 0.25 and inp.sonars[5] < 0.25) or inp.sonars[3]<0.15 or inp.sonars[4]<0.15 or (inp.sonars[3] < 0.2 and inp.sonars[4] < 0.2) or inp.sonars[2] + inp.sonars[3] + inp.sonars[4] + inp.sonars[6] < 0.75)
5) else
6) inp.sonars[3]>0.5 and inp.sonars[4]>0.5 and inp.sonars[0]>0.5 and inp.sonars[7]>0.5
7) inp.sonars[3]>0.5 and inp.sonars[4]>0.5 and inp.sonars[0]>0.5 and inp.sonars[7]>0.5
8) (inp.sonars[2] < 0.25 and inp.sonars[5] < 0.25) or inp.sonars[3]<0.15 or inp.sonars[4]<0.15 or (inp.sonars[3] < 0.2 and inp.sonars[4] < 0.2) or inp.sonars[2] + inp.sonars[3] + inp.sonars[4] + inp.sonars[6] < 0.75)
9) else