

ECE 8843 Autonomous Control of Robotic Systems

Fall 2011 Homework Assignment 3

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Assignment

The assignment is to write code for a learning algorithm (reinforcement learning, neural networks, or genetic algorithms) that learns the control strategies for Robby the Robot whose goal is to collect cans in a room.

1 Solution

1.1 Learning Algorithm

To allow this robot to learn, this program utilizes the basic reinforcement learning model. First, we identify the current state using the function `canDet.m`. Next, the robot makes a decision and then performs an action using `robotDecision.m` and then `robotAct.m`. From here, the reward is calculated and assessed using `scoreFunc.m`, `myScoreFunc.m`, and `robotEval.m`. Finally, the robot inputs the learned data outputted from `robotEval.m` into the `learnedStrat` matrix.

The setup for the test run involved two phases: a learning phase and then a testing phase. For reinforcement learning, it is necessary to define a point of convergence to which the learning algorithm must approach. For this algorithm, using 2000 actions for a single run, the necessary point of convergence was when the `robotScore` variable consistently exceeded 150 points and the robot picked up all but at most four cans.

The robot's reward is partially defined using the scoring for the assignment. So, -5 points for running into a wall, -1 point for trying to pick up a non-existent can, and +10 for picking up a can. The rest of the reward is defined with -1 point for the robot not picking up a can that it had access to, -6 points if the robot does not move towards a can in the Northern direction, -7 points if the robot does not move towards a can in the Southern direction, -8 points if the robot does not move towards a can in the Eastern direction, and -9 points if the robot does not move towards a can in the Western direction. The values of each of these actions is arbitrary for the actual learning. They are used for coding purposes only. Once the desired action is identified with the scoring, the actions are then added to the table for the appropriate scenario.

1.2 Lookup Table

See Appendix 3.2.

1.3 Performance Scores

Origin	Performance Score
9, 1	150
8, 2	150
2, 8	140
5, 5	160
0, 0	150

1.4 Sequence of Actions

See Appendix 3.1.

2 Conclusion

2.1 Notes on the Plot

- 1) The plots were created by making three layers of a 10 pixel-by-10 pixel array and then using the MATLAB imwrite command followed by imresize to make the image large enough to view. The imresize has the unfortunate side effect of blurring the edges of the objects in the image. Due to the blur, sometimes it seems as if the robot is sitting on top of an object.
- 2) Also, because of this method of plotting, sometimes, when the robot is in the same position as a can, it seems to disappear. This is because its color goes behind the can's color in the RGB space.

3 Appendix

3.1 Sequence of Actions

List of Actions									
#	Action	#	Action	#	Action	#	Action	#	Action
1	4	44	0	87	5	130	5	173	3
2	2	45	0	88	5	131	5	174	5
3	0	46	3	89	0	132	2	175	5
4	5	47	1	90	0	133	2	176	5
5	0	48	4	91	3	134	5	177	5
6	0	49	2	92	5	135	5	178	5
7	2	50	0	93	0	136	5	179	5
8	4	51	3	94	0	137	0	180	5
9	2	52	5	95	3	138	0	181	5
10	4	53	0	96	1	139	1	182	5
11	1	54	4	97	5	140	3	183	5
12	4	55	5	98	5	141	5	184	5
13	5	56	5	99	5	142	3	185	5
14	5	57	5	100	0	143	3	186	3
15	2	58	0	101	1	144	1	187	2
16	4	59	4	102	0	145	2	188	0
17	2	60	5	103	3	146	2	189	0
18	5	61	5	104	1	147	5	190	0
19	5	62	2	105	5	148	5	191	3
20	5	63	5	106	5	149	5	192	5
21	5	64	5	107	5	150	5	193	3
22	1	65	5	108	5	151	5	194	5
23	4	66	0	109	5	152	5	195	5
24	2	67	4	110	3	153	5	196	5
25	5	68	3	111	1	154	2	197	2
26	5	69	4	112	5	155	3	198	5
27	5	70	1	113	1	156	2	199	5
28	2	71	4	114	5	157	0	200	5
29	5	72	5	115	3	158	3		
30	5	73	1	116	1	159	2		
31	5	74	2	117	5	160	3		
32	2	75	5	118	5	161	5		
33	4	76	5	119	2	162	0		
34	5	77	3	120	5	163	1		
35	5	78	4	121	2	164	0		
36	5	79	5	122	2	165	3		
37	5	80	5	123	5	166	1		
38	5	81	1	124	5	167	5		
39	5	82	4	125	2	168	5		
40	2	83	5	126	3	169	2		
41	3	84	2	127	5	170	5		
42	2	85	5	128	5	171	2		
43	0	86	5	129	5	172	0		

Start
9, 1

3.2 Lookup Table

Legend			
N,S,E,W,C	Definition	Actions	Definition
0	No Object	0	Move North
1	Can	1	Move South
2	Wall	2	Move East
		3	Move West
		4	Pick Up Can
		5	Move randomly
		6	Stay Put
		7	No Data For Scenario
		8	Insufficient Data

Lookup Table					
North	South	East	West	Current	Actions
0	0	0	0	0	8
0	0	0	0	1	4
0	0	0	0	2	7
0	0	0	1	0	3
0	0	0	1	1	4
0	0	0	1	2	7
0	0	0	2	0	8
0	0	0	2	1	4
0	0	0	2	2	7
0	0	1	0	0	2
0	0	1	0	1	4
0	0	1	0	2	7
0	0	1	1	0	2
0	0	1	1	1	7
0	0	1	1	2	7
0	0	1	2	0	2
0	0	1	2	1	7
0	0	1	2	2	7
0	0	2	0	0	8
0	0	2	0	1	7
0	0	2	0	2	7
0	0	2	1	0	7
0	0	2	1	1	7
0	0	2	1	2	7
0	0	2	2	0	7
0	0	2	2	1	7
0	0	2	2	2	7
0	1	0	0	0	1
0	1	0	0	1	4
0	1	0	0	2	7
0	1	0	1	0	1
0	1	0	1	1	4
0	1	0	1	2	7
0	1	0	2	0	1
0	1	0	2	1	7
0	1	0	2	2	7
0	1	1	0	0	1
0	1	1	0	1	7
0	1	1	0	2	7
0	1	1	1	0	7
0	1	1	1	1	7
0	1	1	1	2	7
0	1	1	2	0	7
0	1	1	2	1	7
0	1	1	2	2	7
0	1	2	0	0	7
0	1	2	0	1	7
0	1	2	0	2	7

North	South	East	West	Current	Actions
0	1	2	1	0	7
0	1	2	1	1	7
0	1	2	1	2	7
0	1	2	2	0	7
0	1	2	2	1	7
0	1	2	2	2	7
0	2	0	0	0	8
0	2	0	0	1	7
0	2	0	0	2	7
0	2	0	1	0	7
0	2	0	1	1	7
0	2	0	1	2	7
0	2	0	2	0	8
0	2	0	2	1	4
0	2	0	2	2	7
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0	2	2	1	2	7
0	2	2	2	0	7
0	2	2	2	1	7
0	2	2	2	2	7
1	0	0	0	0	0
1	0	0	0	1	4
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1	0	0	1	1	7
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1	0	0	2	1	7
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1	0	1	0	1	7
1	0	1	0	2	7
1	0	1	1	0	7
1	0	1	1	1	7
1	0	1	1	2	7

North	South	East	West	Current	Actions
1	0	1	2	0	7
1	0	1	2	1	7
1	0	1	2	2	7
1	0	2	0	0	7
1	0	2	0	1	7
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1	2	0	2	2	7
1	2	0	2	0	7
1	2	0	2	1	7
1	2	0	2	2	7

North	South	East	West	Current	Actions
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1	2	1	0	1	7
1	2	1	0	2	7
1	2	1	1	0	7
1	2	1	1	1	7
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2	0	2	2	2	7
2	1	0	0	0	1
2	1	0	0	1	4
2	1	0	0	2	7

North	South	East	West	Current	Actions
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2	1	0	1	1	7
2	1	0	1	2	7
2	1	0	2	0	7
2	1	0	2	1	7
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