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AML Homework 4

-2.2 -2 -0.3 0.1 0.2 0.4 1.6 1.7 1.9 2.0

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	MEAN
-2.2	P1	0	0.2	1.9	2.3	2.4	2.6	3.8	3.9	4.1	4.2
-2	P2	0	1.7	2.1	2.2	2.4	3.6	3.7	3.9	4	
-0.3	P3	0	0.4	0.5	0.7	1.9	2	2.2	2.3		
0.1	P4		0	0.1	0.3	1.5	1.6	1.8	1.9		
0.2	P5			0	0.2	1.8	1.5	1.7	1.8		
0.4	P6				0	1.2	1.3	1.5	1.6		
1.6	P7					0	0.1	0.3	0.4		
1.7	P8						0	0.2	0.3		
1.9	P9							0	0.1		
2	P10								0		

The distance matrix for the points

→ Single Link

① $P_4 - P_5$
 $P_7 - P_8$
 $P_9 - P_{10}$

② $P_1 - P_2$
 $(P_4 - P_5) - P_6$
 $(P_2 - P_8) - (P_9 - P_{10})$

③ $P_3 - (P_4, P_5, P_6)$
 $\{ 0.4 \}$
 $\text{MIN}(0.4, 0.6, 0.7)$

$\min(1.9, 2, \dots, 1.2, 1.3, 1.8, 1.5)$

$$\textcircled{4} \quad (P_3 P_4 P_6 P_6) - (P_7 P_8 P_9 P_{10}) \quad \left\{ \begin{array}{l} \\ \end{array} \right. \textcircled{1.2}$$

$$\textcircled{5} \quad (P_1 P_2) - (P_3 P_4 P_5 P_6 P_7 P_8 P_9 P_{10}) \quad \left\{ \begin{array}{l} \\ \end{array} \right. \textcircled{1.7}$$

$\min(1.9, 1.7, \dots, 4.2, 4)$

single link

1.7

1.2

0.4

0.2

0.1

$P_1 \quad P_2 \quad P_3 \quad P_4 \quad P_5 \quad P_6 \quad P_7 \quad P_8 \quad P_9 \quad P_{10} \quad P.$

-2.2 -2 -0.3 0.1 0.2 0.4 1.6 1.7 1.9 2.0

→ Complete Link :

$$\begin{array}{l} \textcircled{1} \quad P_4 - P_6 \\ P_7 - P_8 \\ P_9 - P_{10} \end{array} \quad \left. \begin{array}{c} \\ \\ \end{array} \right\} 0.1$$

$$\textcircled{2} \quad P_1 - P_2 \quad \left. \begin{array}{c} \\ \end{array} \right\} 0.2$$

$$\textcircled{3} \quad P_3 - (P_4 \ P_5 \ P_6) = \max(0.4, 0.5, 0.7) = 0.7 \quad \left. \begin{array}{c} \\ \end{array} \right\}$$

$$\textcircled{4} \quad (P_7 - P_8) - (P_9 - P_{10}) = \max(0.3, 0.4, 0.2, 0.3) = 0.4 \quad \left. \begin{array}{c} \\ \end{array} \right\}$$

$$\textcircled{5} \quad (P_3 \ P_4 \ P_5 \ P_6) - (P_7 \ P_8 \ P_9 \ P_{10})$$

$$= \max(0.4, 0.5, \dots, 1.5, 1.6)$$

$$= \textcircled{2.3}$$

$$(P_3 \ P_4 \ P_5 \ P_6) - (P_1 \ P_2)$$

$$= \max(1.9, 2.3, 2.4, 2.6, 1.7, 2.1, 2.2, 2.4)$$

$$= \textcircled{2.6} \times$$

$$\textcircled{6} \quad (P_1 \ P_2) - (P_3 \ P_4 \ P_5 \ P_6 \ P_7 \ P_8 \ P_9 \ P_{10})$$

$$= \max(0.2, \dots, 4.2, \dots, 0.1)$$

$$= \textcircled{4.2}$$

4.2

Complete Link

2.3

0.7

0.4

0.3

0.2

0.1

$P_1 \ P_2 \ P_3 \ P_4 \ P_5 \ P_6 \ P_7 \ P_8 \ P_9 \ P_{10}$

-2.2 -2 -0.3 0.1 0.2 0.4 1.6 1.7 1.9 2.0

Iteration 1 :

	X	Y	S. No. of points
Centroid 1	0	0	1 (biomass)
Centroid 2	4	3	5 (biomass)

P	X	Y	Dist from C ₁	Dist fr. C ₂
P ₁	2	1	2.23606	2.8284
P ₂	0	10	1.58	4.4721
P ₃	2.5	2.5	2.8284	2.23606
P ₄	4	0	4.4721	3
P ₅	6	1	6.0827	2.8284

x ₁	Cen 1)	Cluster 1	1
x ₂	Cen 1)	Cluster 1	2
x ₃	Cen 2)	Cluster 2	3
x ₄	Cen 2)	Cluster 2	4
x ₅	Cen 2)	Cluster 2	5

New Centroid :

$$\text{Cluster 1} = (2+0)/2, (1+1)/2$$

$$\text{Cent 1} = (1.5, 1)$$

$$\text{Cluster 2} = (2+4+6)/3, (2+0+1)/3$$

$$\text{Cent 2} = (4, 1)$$

Iteration 2 :

	X	Y	
Centroid 1	1	1	
Centroid 2	4	1	

	X	Y	Dist for C ₁	Dist for C ₂
x ₁	2	1	1	2
x ₂	0	1	1	4
x ₃	2	2	1.414	2.3606
x ₄	4	0	3.162	1
x ₅	6	1	5	2

x ₁	Cent 1	Cluster 1	1
x ₂	Cent 1	Cluster 1	1
x ₃	Cent 1	Cluster 2	-1
x ₄	Cent 2	Cluster 2	-1
x ₅	Cent 2	Cluster 2	1

New Centroid

$$\text{Cluster 1} \quad (2+0+2)/3, (1+1+2)/3 \\ \underline{\text{Cent 1}} \quad (1.333, 1.333)$$

$$\text{Cluster 2} \quad (4+6)/2, (0+1)/2 \\ \underline{\text{Cent 2}} \quad (5), 0.5$$

c) If we have new point $x_6 = (2, 3)$

Plot from C_1 to C_2

$d(C_1, x_6) = 1.7950$ and $d(C_2, x_6) = 3.905$

Since x_6 is closer to C_1 , hence it is part of

cluster C_1 . Hence label

x_1

1

2

majority class

x_2

1

2

(1)

x_3

1

2

(1)

Hence label of x_6 is (1)

nearest point

to x_6 is x_1 and x_2

more than x_3 and x_4

nearest point to x_6 is x_1 and x_2

more than x_3 and x_4

nearest point to x_6 is x_1 and x_2

more than x_3 and x_4

more than x_5 and x_6

2 points

nearest point to x_6 is x_1 and x_2

more than x_3 and x_4

points

<p>3) Value iteration</p> <ul style="list-style-type: none"> 1) Here we start with 0 value for all states and recursively updating the value using Bellman update formula. 2) It may take more time to converge. 	<p>Short Policy Iteration</p> <ul style="list-style-type: none"> 1) It evaluates policies by calculating utilities for some fixed policy until convergence, the improved policy by updating it using one-step lookahead. 2) Under some conditions it may take less time to converge.
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Q-Learning	Value iteration
1) In Q-Learning the agent does not have knowledge of the transition and reward functions.	1) Here we do not make such an assumption.
2) It has state action pair	2) It has only state as it is for all actions
3) Most practical applications use Q-learning	3) It is preferred when S & R are known

A

	13	(14)	15	16	17	18	Goal
2603	41602	9	10	11	12	13	2603
41603		10	11	12	13	14	41603
41604		11	12	13	14	15	41604
41605		12	13	14	15	16	41605
41606		13	14	15	16	17	41606
41607		14	15	16	17	18	41607
41608		15	16	17	18	19	41608
41609		16	17	18	19	20	41609
41610		17	18	19	20	21	41610
41611		18	19	20	21	22	41611
41612		19	20	21	22	23	41612
41613		20	21	22	23	24	41613
41614		21	22	23	24	25	41614
41615		22	23	24	25	26	41615
41616		23	24	25	26	27	41616
41617		24	25	26	27	28	41617
41618		25	26	27	28	29	41618
41619		26	27	28	29	30	41619
41620		27	28	29	30	31	41620
41621		28	29	30	31	32	41621
41622		29	30	31	32	33	41622
41623		30	31	32	33	34	41623
41624		31	32	33	34	35	41624
41625		32	33	34	35	36	41625
41626		33	34	35	36	37	41626
41627		34	35	36	37	38	41627
41628		35	36	37	38	39	41628
41629		36	37	38	39	40	41629
41630		37	38	39	40	41	41630
41631		38	39	40	41	42	41631
41632		39	40	41	42	43	41632
41633		40	41	42	43	44	41633
41634		41	42	43	44	45	41634
41635		42	43	44	45	46	41635
41636		43	44	45	46	47	41636
41637		44	45	46	47	48	41637
41638		45	46	47	48	49	41638
41639		46	47	48	49	50	41639
41640		47	48	49	50	51	41640
41641		48	49	50	51	52	41641
41642		49	50	51	52	53	41642
41643		50	51	52	53	54	41643
41644		51	52	53	54	55	41644
41645		52	53	54	55	56	41645
41646		53	54	55	56	57	41646
41647		54	55	56	57	58	41647
41648		55	56	57	58	59	41648
41649		56	57	58	59	60	41649
41650		57	58	59	60	61	41650
41651		58	59	60	61	62	41651
41652		59	60	61	62	63	41652
41653		60	61	62	63	64	41653
41654		61	62	63	64	65	41654
41655		62	63	64	65	66	41655
41656		63	64	65	66	67	41656
41657		64	65	66	67	68	41657
41658		65	66	67	68	69	41658
41659		66	67	68	69	70	41659
41660		67	68	69	70	71	41660
41661		68	69	70	71	72	41661
41662		69	70	71	72	73	41662
41663		70	71	72	73	74	41663
41664		71	72	73	74	75	41664
41665		72	73	74	75	76	41665
41666		73	74	75	76	77	41666
41667		74	75	76	77	78	41667
41668		75	76	77	78	79	41668
41669		76	77	78	79	80	41669
41670		77	78	79	80	81	41670
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41672		79	80	81	82	83	41672
41673		80	81	82	83	84	41673
41674		81	82	83	84	85	41674
41675		82	83	84	85	86	41675
41676		83	84	85	86	87	41676
41677		84	85	86	87	88	41677
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41679		86	87	88	89	90	41679
41680		87	88	89	90	91	41680
41681		88	89	90	91	92	41681
41682		89	90	91	92	93	41682
41683		90	91	92	93	94	41683
41684		91	92	93	94	95	41684
41685		92	93	94	95	96	41685
41686		93	94	95	96	97	41686
41687		94	95	96	97	98	41687
41688		95	96	97	98	99	41688
41689		96	97	98	99	100	41689
41690		97	98	99	100	101	41690
41691		98	99	100	101	102	41691
41692		99	100	101	102	103	41692
41693		100	101	102	103	104	41693
41694		101	102	103	104	105	41694
41695		102	103	104	105	106	41695
41696		103	104	105	106	107	41696
41697		104	105	106	107	108	41697
41698		105	106	107	108	109	41698
41699		106	107	108	109	110	41699
41700		107	108	109	110	111	41700
41701		108	109	110	111	112	41701
41702		109	110	111	112	113	41702
41703		110	111	112	113	114	41703
41704		111	112	113	114	115	41704
41705		112	113	114	115	116	41705
41706		113	114	115	116	117	41706
41707		114	115	116	117	118	41707
41708		115	116	117	118	119	41708
41709		116	117	118	119	120	41709
41710		117	118	119	120	121	41710
41711		118	119	120	121	122	41711
41712		119	120	121	122	123	41712
41713		120	121	122	123	124	41713
41714		121	122	123	124	125	41714
41715		122	123	124	125	126	41715
41716		123	124	125	126	127	41716
41717		124	125	126	127	128	41717
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41719		126	127	128	129	130	41719
41720		127	128	129	130	131	41720
41721		128	129	130	131	132	41721
41722		129	130	131	132	133	41722
41723		130	131	132	133	134	41723
41724		131	132	133	134	135	41724
41725		132	133	134	135	136	41725
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41733		140	141	142	143	144	41733
41734		141	142	143	144	145	41734
41735		142	143	144	145	146	41735
41736		143	144	145	146	147	41736
41737		144	145	146	147	148	41737
41738		145	146	147	148	149	41738
41739		146	147	148	149	150	41739
41740		147	148	149	150	151	41740
41741		148	149	150	151	152	41741
41742		149	150	151	152	153	41742
41743		150	151	152	153	154	41743
41744		151	152	153	154	155	41744
41745		152	153	154	155	156	41745
41746		153	154	155	156	157	41746
41747		154	155	156	157	158	41747
41748		155	156	157	158	159	41748
41749		156	157	158	159	160	41749
41750		157	158	159	160	161	41750
41751		158	159	160	161	162	41751
41752		159	160	161	162	163	41752
41753		160	161	162	163	164	41753
41754		161	162	163	164	165	41754
41755		162	163	164	165	166	41755
41756		163	164	165	166	167	41756
41757		164	165	166	167	168	41757
41758		165	166	167	168	169	41758
41759		166	167	168	169	170	41759
41760		167	168	169	170	171	41760
41761		168	169	170	171	172	41761
41762		169	170	171	172	173	41762
41763		170	171	172	173	174	41763
41764		171	172	173	174	175	41764
41765		172	173	174	175	176	41765
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41774		181	182	183	184	185	41774
41775		182	183	184	185	186	41775
41776		183	184	185	186	187	41776
41777		184	185	186	187	188	41777
41778		185	186	187	188	189	41778
41779		186	187	188	189	190	41779
41780		187	188	189	190	191	41780
41781		188	189	190	191	192	41781
41782		189	190	191	192	193	41782
41783		190	191	192	193	194	41783
41784		191	192	193	194	195	41784
41785		192	193	194	195	196</td	

on (if) you will "start" the game.

Discount:

$$\text{Gamma } (\gamma) = 0.95 \text{ without noise} \\ \text{gamma} = (12, 0, 2) T$$

Assuming the direction:

1

1

associated with each state.

\Rightarrow State information ~~(s)~~ (s)

- gold present? {Yes / No}
- open door direction? {North, south, east, west}
- state numbers {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16}.

\Rightarrow Actions: (A)

{ move up, move down, move left, move right,

open north door, open south door,
open east door, open west door}

\Rightarrow Transition function: (T):

$T(s, a, s')$ = Probability.

$T(\{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}, \text{north door opens} +$
"move north", go in state
 $(s+5)$) = 1

$T(\{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15\}, \text{east door opens} +$
"move left", go in state left of
current state, $(s+3)$) = 1

T (open north door open, more north door open)
 T (open south door open, more south door open)
 T (open east door open, more east door open)
 T (open west door, west door open).

se

$T(\{5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16\}, \text{south door open}$
 + "more south", go in state below
 the current state ($S \rightarrow S'$))

block - Riddle - 60) \oplus \oplus = 1 = 1

(c) 2 send reward of 1.

$T(\{2, 3, 4, 6, 7, 8, 10, 11, 12, 14, 15, 16\}, \text{west door open}$
 + "more west", go in state left of
 current state ($S \rightarrow S'$))

not enough doors left in upwards path 21 = 1

V_{old} bottom gold top (1) = 1

\Rightarrow Reward function! task = 0.5

R(s, a, s') if $s' = \text{bottom}$, 0.5

if $s' = \text{top}$, 0.5 and if $s' = \text{middle}$

with side door 0.5

① Goal is to reach the gold with opening minimum number of doors

$$R = \begin{cases} +10 & \text{for getting gold} \\ -1 & \text{for each door opened} \\ & \text{step taken} \end{cases}$$

0 for anything else

(e) The goal is to reach the gold with minimum number of steps

$$R = \begin{cases} +10 & \text{for getting gold} \\ -1 & \text{for taken any step} \\ 0 & \text{for everything else} \end{cases}$$

((The) difference between ① & ② is the change in the reward function

in ① you are penalized for opening a door, while in ② you

are penalized for taking a step

through the door, the objective is

different

blok gitter red 0

bombe rood blauw 1

results of step

gold gitter red 0

Given: $P(y=1|x) = \frac{e^{\psi(x;y)}}{1+e^{\psi(x;y)}}$

taking log on both sides,

$$\log(P(y=1|x)) = \log\left(\frac{e^{\psi(x;y)}}{1+e^{\psi(x;y)}}\right)$$

$$\log(P(y=1|x)) = \log(e^{\psi(x;y)}) - \log(1+e^{\psi(x;y)})$$

$$\therefore \log[P(y=1|x)] = e^{\psi(x;y)} - \log(1+e^{\psi(x;y)})$$

Differentiating both sides w.r.t $\psi(x_i, y_i)$

$$\frac{\partial}{\partial \psi(x_i, y_i)} \log(P(y=1|x))$$

$$= \frac{\partial}{\partial \psi(x_i, y_i)} \psi(x_i, y_i) - \frac{\partial}{\partial \psi(x_i, y_i)} [\log(1+e^{\psi(x_i, y_i)})]$$

$$= I - \frac{1}{1+e^{\psi(x_i, y_i)}} \frac{\partial}{\partial \psi(x_i, y_i)} e^{\psi(x_i, y_i)}$$

$\approx I - \frac{1}{1+e^{\psi(x_i, y_i)}}$

$$= I - \frac{1}{1 + e^{\phi(x; y)}} \times e^{\phi(x; y)} \times (1)$$

$$= I - \frac{e^{\psi(x; y)}}{1 + e^{\psi(x; y)}}$$

Thus,

$$\frac{\partial \log P(y_i=1/x_i)}{\partial \psi(x_i; y_i)} = I(y_i=1) - P(y_i=1/x_i)$$