Umut Deniz Şener – 2018400225
Leyla Yayladere - 2018400216

CMPE 300 ANALYSIS OF ALGORITHMS

PROJECT 3 - ANSWERS

PART 1

d) (You can adjust the length of the tables)

Success, n=6

Step	Columns	Available
1	[2, None, None, None, None, None]	[0, 4, 5]
2	[2, 5, None, None, None, None]	[1, 3]
3	[2, 5, 1, None, None, None]	[4]
4	[2, 5, 1, 4, None, None]	[0]
5	[2, 5, 1, 4, 0, None]	[3]
6	[2, 5, 1, 4, 0, 3]	[]

Visualization of the table

	0	1	2	3	4	5
0			Q			
1						Q
2		Q				
3					Q	
4	Q					
5				Q		

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Success, n=6

Step	Columns	Available
1	[1, None, None, None, None, None]	[3, 4, 5]
2	[1, 3, None, None, None, None]	[0, 5]
3	[1, 3, 5, None, None, None]	[0, 2]
4	[1, 3, 5, 0, None, None]	[2, 4]
5	[1, 3, 5, 0, 2, None]	[4]
6	[1, 3, 5, 0, 2, 4]	[]

Visualization of the table

	0	1	2	3	4	5
0		Q				
1				Q		
2						Q
3	Q					
4			Q			
5					Q	

Failure, n=6

Step	Columns	Available
1	[4, None, None, None, None, None]	[0, 1, 2]
2	[4, 1, None, None, None, None]	[3, 5]
3	[4, 1, 3, None, None, None]	[0, 5]
4	[4, 1, 3, 5, None, None]	[2]
5	[4, 1, 3, 5, 2, None]	[]

Failure, n=6

Step	Columns	Available
1	[5, None, None, None, None, None]	[0, 1, 2, 3]
2	[5, 0, None, None, None, None]	[2, 4]
3	[5, 0, 4, None, None, None]	[1]
4	[5, 0, 4, 1, None, None]	[]

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Success, n=8

Step	Columns	Available
1	[6, None, None, None, None, None, None, None]	[0, 1, 2, 3, 4]
2	[6, 1, None, None, None, None, None, None]	[3, 5, 7]
3	[6, 1, 5, None, None, None, None, None]	[0, 2, 7]
4	[6, 1, 5, 2, None, None, None, None]	[0]
5	[6, 1, 5, 2, 0, None, None, None]	[3, 7]
6	[6, 1, 5, 2, 0, 3, None, None]	[7]
7	[6, 1, 5, 2, 0, 3, 7, None]	[4]
8	[6, 1, 5, 2, 0, 3, 7, 4]	[]

Visualization of the table

	0	1	2	3	4	5	6	7
0							Q	
1		Q						
2						Q		
3			Q					
4	Q							
5				Q				
6								Q
7					Q			

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Success, n=8

Step	Columns	Available
1	[3, None, None, None, None, None, None, None]	[0, 1, 5, 6, 7]
2	[3, 7, None, None, None, None, None, None]	[0, 2, 4]
3	[3, 7, 0, None, None, None, None, None]	[2, 4]
4	[3, 7, 0, 4, None, None, None, None]	[1, 6]
5	[3, 7, 0, 4, 6, None, None, None]	[1]
6	[3, 7, 0, 4, 6, 1, None, None]	[5]
7	[3, 7, 0, 4, 6, 1, 5, None]	[2]
8	[3, 7, 0, 4, 6, 1, 5, 2]	[]

Visualization of the table

	0	1	2	3	4	5	6	7
0				Q				
1								Q
2	Q							
3					Q			
4							Q	
5		Q						
6						Q		
7			Q					

Failure, n=8

Step	Columns	Available
1	[5, None, None, None, None, None, None, None]	[0, 1, 2, 3, 7]
2	[5, 2, None, None, None, None, None, None]	[0, 4, 6]
3	[5, 2, 0, None, None, None, None, None]	[3, 6, 7]
4	[5, 2, 0, 6, None, None, None, None]	[3, 4]
5	[5, 2, 0, 6, 4, None, None, None]	[1, 7]
6	[5, 2, 0, 6, 4, 1, None, None]	[]

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Failure, n=8

Step	Columns	Available
1	[5, None, None, None, None, None, None, None]	[0, 1, 2, 3, 7]
2	[5, 3, None, None, None, None, None, None]	[0, 1, 6]
3	[5, 3, 6, None, None, None, None, None]	[0, 4]
4	[5, 3, 6, 4, None, None, None, None]	[2, 7]
5	[5, 3, 6, 4, 2, None, None, None]	[]

Success, n=10

Step	Columns	Available
1	[5, None, None, None, None, None, None, None, None, None]	[0, 1, 2, 3, 7, 8, 9]
2	[5, 7, None, None, None, None, None, None, None, None]	[0, 1, 2, 4, 9]
3	[5, 7, 2, None, None, None, None, None, None, None]	[0, 4, 6]
4	[5, 7, 2, 4, None, None, None, None, None, None]	[6, 8]
5	[5, 7, 2, 4, 8, None, None, None, None, None]	[1]
6	[5, 7, 2, 4, 8, 1, None, None, None, None]	[3, 9]
7	[5, 7, 2, 4, 8, 1, 9, None, None, None]	[6]
8	[5, 7, 2, 4, 8, 1, 9, 6, None, None]	[3]
9	[5, 7, 2, 4, 8, 1, 9, 6, 3, None]	[0]
10	[5, 7, 2, 4, 8, 1, 9, 6, 3, 0]	[]

Visualization of the table

	0	1	2	3	4	5	6	7	8	9
0						Q				
1								Q		
2			Q							
3					Q					
4									Q	
5		Q								
6										Q
7							Q			
8				Q						
9	Q									

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Success, n=10

Step	Columns	Available
1	[8, None, None, None, None, None, None, None, None, None]	[0, 1, 2, 3, 4, 5, 6]
2	[8, 3, None, None, None, None, None, None, None, None]	[0, 1, 5, 7, 9]
3	[8, 3, 1, None, None, None, None, None, None, None]	[4, 6, 7, 9]
4	[8, 3, 1, 7, None, None, None, None, None, None]	[2, 5, 9]
5	[8, 3, 1, 7, 2, None, None, None, None, None]	[0, 6]
6	[8, 3, 1, 7, 2, 0, None, None, None, None]	[6, 9]
7	[8, 3, 1, 7, 2, 0, 6, None, None, None]	[4]
8	[8, 3, 1, 7, 2, 0, 6, 4, None, None]	[9]
9	[8, 3, 1, 7, 2, 0, 6, 4, 9, None]	[5]
10	[8, 3, 1, 7, 2, 0, 6, 4, 9, 5]	[]

Visualization of the table

	0	1	2	3	4	5	6	7	8	9
0									Q	
1				Q						
2		Q								
3								Q		
4			Q							
5	Q									
6							Q			
7					Q					
8										Q
9						Q				

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Failure, n=10

Step	Columns	Available
1	[6, None, None, None, None, None, None, None, None, None]	[0, 1, 2, 3, 4, 8, 9]
2	[6, 0, None, None, None, None, None, None, None, None]	[2, 3, 5, 7, 9]
3	[6, 0, 3, None, None, None, None, None, None, None]	[1, 5, 7, 8]
4	[6, 0, 3, 8, None, None, None, None, None, None]	[4]
5	[6, 0, 3, 8, 4, None, None, None, None, None]	[2, 7, 9]
6	[6, 0, 3, 8, 4, 2, None, None, None, None]	[9]
7	[6, 0, 3, 8, 4, 2, 9, None, None, None]	[5]
8	[6, 0, 3, 8, 4, 2, 9, 5, None, None]	[1]
9	[6, 0, 3, 8, 4, 2, 9, 5, 1, None]	[]

Failure, n=10

Step	Columns	Available
1	[4, None, None, None, None, None, None, None, None, None]	[0, 1, 2, 6, 7, 8, 9]
2	[4, 7, None, None, None, None, None, None, None, None]	[0, 1, 3, 5, 9]
3	[4, 7, 3, None, None, None, None, None, None, None]	[0, 6, 8]
4	[4, 7, 3, 6, None, None, None, None, None, None]	[2, 9]
5	[4, 7, 3, 6, 2, None, None, None, None, None]	[5]
6	[4, 7, 3, 6, 2, 5, None, None, None, None]	[1, 8]
7	[4, 7, 3, 6, 2, 5, 8, None, None, None]	[0]
8	[4, 7, 3, 6, 2, 5, 8, 0, None, None]	[]

d)

n	Number of Success	Number of Trials	Probability
6	742	10000	0.0742
8	1305	10000	0.1305
10	619	10000	0.0619

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PART 2

c)

n = 6

k	Number of Success	Number of Trials	Probability
0	10000	10000	1.0000
1	6670	10000	0.6670
2	2240	10000	0.2240
3	1112	10000	0.1112
4	835	10000	0.0835
5	916	10000	0.0916

n = 8

k	Number of Success	Number of Trials	Probability
0	10000	10000	1.0000
1	10000	10000	1.0000
2	8685	10000	0.8685
3	5017	10000	0.5017
4	2601	10000	0.2601
5	1653	10000	0.1653
6	1926	10000	0.1926
7	3035	10000	0.3035

n = 10

k	Number of Success	Number of Trials	Probability
0	10000	10000	1.0000
1	10000	10000	1.0000
2	10000	10000	1.0000
3	8042	10000	0.8042
4	4271	10000	0.4271
5	1953	10000	0.1953
6	1166	10000	0.1166
7	880	10000	0.0880
8	1162	10000	0.1162
9	2026	10000	0.2026

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d) Comments

- Normally, as k increases, probability of getting correct result decreases. Because algorithm is getting more randomness (it is getting closer to the Las Vegas Algorithm and when k = n, it's totally a Las Vegas algorithm) as k increases, and the deterministic part is getting smaller, probability of getting correct result decreases as expected. However, in part 2, we run the Las Vegas algorithm over and over until it puts k many queens on the board successfully as stated in the Moodle project discussion page. Therefore, some of incorrect paths of choosing columns until k value will be eliminated and after some value of k that is close to n, this elimination is getting more significant and thus we can see it on the table that probability starts to increase instead of general decreasing pattern.
- Although probability of getting correct result decreases as k increases until some value that is close to n, the execution time of algorithm decreases i.e algorithm is getting faster. Thus, this becomes a tradeoff between speed of algorithm and probability of getting correct results.
- In our all n-values (6, 8, 10), when k is zero, probability of getting correct result is always 1 because algorithm doesn't choose any column randomly i.e it is fully deterministic. Also, we investigate that when n = 8 and k =1, n = 10 and k = 1 or 2, success rate is 1, because size of table is big enough to choose that many random columns.
- In all n (6, 8, 10) for each corresponding k-values in the second part, we observed that probabilities of getting correct result is greater than corresponding probability in the first part as expected. Because we force to run Las Vegas algorithm until it doesn't give an incorrect result for k many rows and after that deterministic algorithm is used in part 2.