

**BILKENT UNIVERSITY**  
**ENGINEERING FACULTY**  
**DEPARTMENT OF COMPUTER ENGINEERING**



**CS461**  
**Homework 3**  
**Group: RIDDLER**

**Team Members**

Göktuğ Gürbüzürk 21702383

Aybars Altınışik 21601054

Ege Şahin 21702300

Zeynep Cankara 21703381

Ahmet Feyzi Halaç 21703206

**The 25 initial states are as follows:**

-- Initial State 1 --

1 - 2 - 3 - 4

2 - 0 - 4 - 5

3 - 3 - 4 - 5

4 - 5 - 5 - 5

-- Initial State 2 --

2 - 3 - 3 - 4

1 - 3 - 4 - 5

2 - 5 - 4 - 5

4 - 5 - 0 - 5

-- Initial State 3 --

2 - 3 - 3 - 4

1 - 3 - 4 - 5

2 - 5 - 5 - 5

4 - 5 - 4 - 0

-- Initial State 4 --

2 - 3 - 3 - 4

1 - 3 - 4 - 5

2 - 5 - 0 - 4

4 - 5 - 5 - 5

-- Initial State 5 --

2 - 3 - 3 - 4

1 - 3 - 0 - 5

2 - 5 - 4 - 4

4 - 5 - 5 - 5

-- Initial State 6 --

2 - 3 - 3 - 4

0 - 1 - 4 - 5

2 - 3 - 5 - 4

4 - 5 - 5 - 5

-- Initial State 7 --

2 - 0 - 3 - 4

1 - 3 - 4 - 5

2 - 3 - 4 - 5

4 - 5 - 5 - 5

-- Initial State 8 --

2 - 3 - 3 - 4

1 - 4 - 5 - 5

2 - 3 - 4 - 0

4 - 5 - 5 - 5

-- Initial State 9 --

2 - 3 - 3 - 4

1 - 3 - 4 - 5

2 - 0 - 4 - 5

4 - 5 - 5 - 5

-- Initial State 10 --

1 - 2 - 3 - 4

2 - 3 - 4 - 5

3 - 0 - 4 - 5

4 - 5 - 5 - 5

-- Initial State 11 --

2 - 3 - 3 - 4

1 - 3 - 4 - 5

2 - 5 - 4 - 5

0 - 4 - 5 - 5

-- Initial State 12 --

2 - 3 - 3 - 4

1 - 3 - 4 - 5

2 - 5 - 5 - 4

4 - 5 - 5 - 0

-- Initial State 13 --

2 - 3 - 3 - 4

1 - 4 - 0 - 5

2 - 3 - 5 - 4

4 - 5 - 5 - 5

-- Initial State 14 --

2 - 3 - 3 - 4

1 - 3 - 4 - 5

2 - 5 - 5 - 0

4 - 5 - 4 - 5

-- Initial State 15 --

2 - 3 - 3 - 4

1 - 3 - 4 - 5

2 - 0 - 5 - 4

4 - 5 - 5 - 5

-- Initial State 16 --

2 - 3 - 3 - 4

1 - 3 - 4 - 5

2 - 5 - 5 - 4

4 - 5 - 0 - 5

-- Initial State 17 --

1 - 2 - 3 - 4

0 - 3 - 4 - 5

2 - 3 - 4 - 5

4 - 5 - 5 - 5

-- Initial State 18 --

2 - 3 - 3 - 4

1 - 3 - 4 - 5

2 - 5 - 0 - 5

4 - 5 - 4 - 5

-- Initial State 19 --

2 - 3 - 3 - 4

1 - 3 - 4 - 5

2 - 5 - 5 - 0

4 - 5 - 5 - 4

-- Initial State 20 --

2 - 3 - 3 - 4

1 - 3 - 4 - 5

2 - 5 - 5 - 4

4 - 0 - 5 - 5

-- Initial State 21 --

0 - 2 - 3 - 4

1 - 3 - 4 - 5

2 - 3 - 4 - 5

4 - 5 - 5 - 5

-- Initial State 22 --

1 - 2 - 3 - 4

2 - 3 - 4 - 5

0 - 3 - 4 - 5

4 - 5 - 5 - 5

-- Initial State 23 --

1 - 2 - 3 - 4

2 - 3 - 4 - 5

3 - 4 - 0 - 5

4 - 5 - 5 - 5

-- Initial State 24 --

2 - 3 - 3 - 4

1 - 3 - 4 - 5

2 - 5 - 5 - 5

4 - 5 - 0 - 4

-- Initial State 25 --

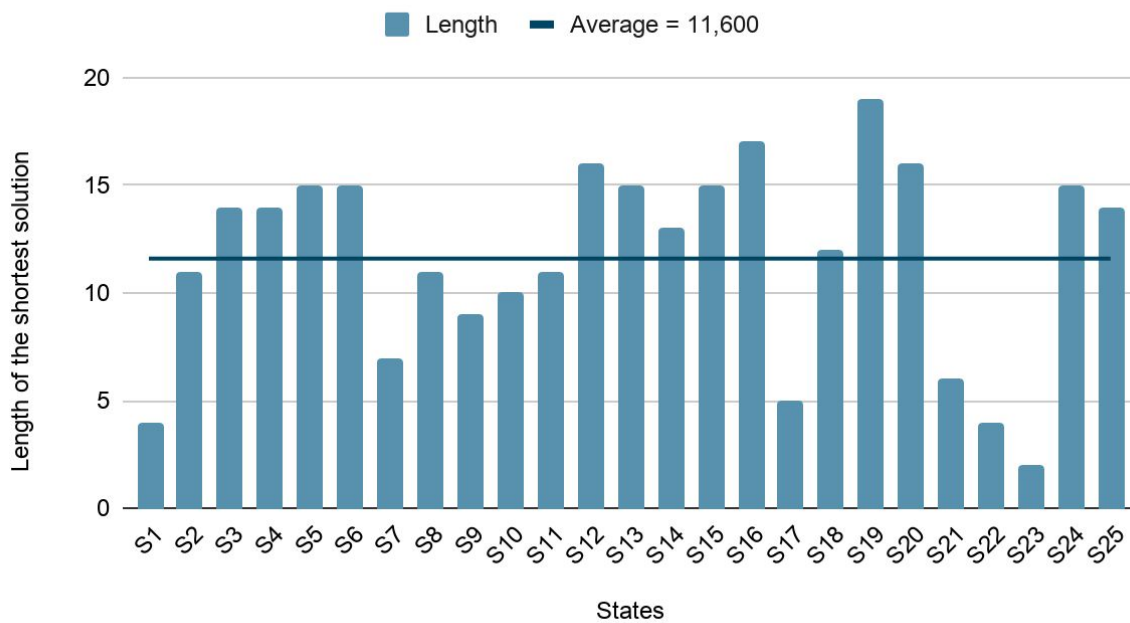
2 - 3 - 3 - 4

1 - 0 - 4 - 5

2 - 3 - 5 - 4

4 - 5 - 5 - 5

**Graph below indicates the length of the shortest solution for each distinct state. Also, it shows the average (over 25 distinct initial states) solution length which is 11.6 in our case.**



2-0-3-4		0-2-3-4		1-2-3-4		1-2-3-4
1-3-4-5		1-3-4-5		0-3-4-5		2-3-4-5
2-3-4-5	<b>2 → right</b>	2-3-4-5	<b>1 → up</b>	2-3-4-5	<b>2 → up</b>	0-3-4-5
4-5-5-5		4-5-5-5		4-5-5-5		4-5-5-5
	1-2-3-4		1-2-3-4		1-2-3-4	
	2-3-4-5		2-3-4-5		2-3-4-5	
<b>3 → left</b>	3-0-4-5	<b>4 → left</b>	3-4-0-5	<b>5 → up</b>	3-4-0-5	<b>5 → left</b>
	4-5-5-5		4-5-5-5		4-5-5-5	
1-2-3-4						
2-3-4-5						
3-4-0-5						
4-5-5-5						

2-3-3-4		2-3-3-4		2-3-3-4		2-3-3-4
1-3-4-5		1-3-4-5		1-3-4-5		1-0-4-5
2-5-5-0	<b>5 → right</b>	2-5-0-5	<b>5 → right</b>	2-0-5-5	<b>3 → down</b>	2-3-5-5
4-5-5-4		4-5-5-4		4-5-5-4		4-5-5-4
	2-0-3-4		0-2-3-4		1-2-3-4	
	1-3-4-5		1-3-4-5		0-3-4-5	
<b>3 → down</b>	2-3-5-5	<b>2 → right</b>	2-3-5-5	<b>1 → up</b>	2-3-5-5	<b>2 → up</b>
	4-5-5-4		4-5-5-4		4-5-5-4	
1-2-3-4		1-2-3-4		1-2-3-4		1-2-3-4
2-3-4-5		2-3-4-5		2-3-4-5		2-3-4-5
0-3-5-5	<b>3 → left</b>	3-0-5-5	<b>5 → up</b>	3-5-5-5	<b>5 → left</b>	3-5-5-5
4-5-5-4		4-5-5-4		4-0-5-4		4-5-0-4
	1-2-3-4		1-2-3-4		1-2-3-4	
	2-3-4-5		2-3-4-5		2-3-4-5	
<b>4 → left</b>	3-5-5-5	<b>5 → down</b>	3-5-5-0	<b>5 → right</b>	3-5-0-5	<b>4 → up</b>
	4-5-4-0		4-5-4-5		4-5-4-5	
1-2-3-4		1-2-3-4		1-2-3-4		1-2-3-4
2-3-4-5		2-3-4-5		2-3-4-5		2-3-4-5
3-5-4-5	<b>5 → right</b>	3-5-4-5	<b>5 → down</b>	3-0-4-5	<b>4 → left</b>	3-4-0-5
4-5-0-5		4-0-5-5		4-5-5-5		4-5-5-5
	1-2-3-4		1-2-3-4			
	2-3-4-5		2-3-4-5			

<b>5</b> → <b>up</b>	3 - 4 - 5 - 5	<b>5</b> → <b>left</b>	3 - 4 - 5 - 5
	4 - 5 - 0 - 5		4 - 5 - 5 - 0