Yan Zhen, Yifan Yao	Action:
CSE 3521	Move 7 right Resultant state:
Homework #3	1 2 3 4 5 6 8 7
1. successor function and goal test function 1 2 3 4 5 6 7 8 Action: Move 4 down Resultant state: 1 2 3 5 6 4 8 7	Number of expanded states is 1 (as expected). 1 2 3 4 5 8 7 6 Action: Move 2 down Resultant state: 1 3 4 2 5 8 7 6
Resultant state: 1 2 3	Move 7 up
4 5 6 8 7 Number of expanded states is 1 (as expected).	Resultant state: 1 2 3 4 7 5 8 6
1 2 3 4 5 6	Action: Move 4 right
8 7 State IS NOT goal state Number of evaluated states is 1 (as expected).	Resultant state: 1 2 3 4 5 8 7 6
1 2 3 8 4 7 6 5	Action: Move 5 left
State IS goal state Number of evaluated states is 1 (as expected). 2. Test functions	Resultant state: 1 2 3 4 5 8 7 6
1 3 4 2 5 8 7 6 Action:	Number of expanded states is 1 (as expected).
Move 6 down Resultant state:	The function is capable to recognize all two,
1 2 3 4 5	three, and four potential successors. Plus,
8 7 6 	the test we ran before (with only two

successors), the function pussed an										
scenarios.	Move 6 left									
3. breadth-first search	1 2 3									
Number of states evaluated=705 Number of states expanded=420 Path length=11	8 4 5 7 6									
	Move 5 down									
1 2 3 4 5 6 8 7	1 2 3 8 4 7 6 5									
Move 8 left	Move 4 right									
1 2 3 4 5 6 8 7	Move 4 right 1 2 3 8 4 7 6 5									
Move 7 left										
1 2 3 4 5 6 8 7	Number of states evaluated=11 Number of states expanded=10 Path length=6									
	Jug 1 volume: 7									
Move 6 down	Jug 2 volume: 0									
1 2 3 4 5	Pour 3gal from Jug 1 into Jug 2									
8 7 6 	Jug 1 volume: 4 Jug 2 volume: 3									
Move 5 right	Empty Jug 2									
1 2 3 4 5 8 7 6	Jug 1 volume: 4 Jug 2 volume: 0									
Move 4 right	Pour 3gal from Jug 1 into Jug 2									
1 2 3 4 5 8 7 6	Jug 1 volume: 1 Jug 2 volume: 3									
	Empty Jug 2									
Move 8 up	 Jug 1 volume: 1									
1 2 3	Jug 2 volume: 0									
8 4 5 7 6	Pour 1gal from Jug 1 into Jug 2									
Move 7 left	Jug 1 volume: 0 Jug 2 volume: 1									
1 2 3 8 4 5	Number of states evaluated=6									

7 6

successors), the function passed all

Number of states expanded=5 Path length=4	 1
Robot Left Left dirt: 1 Right dirt: 1	8 7 6 Move 5 right
Vaccuum: Left dirt 1 -> 0	1 2 3 4 5
Robot Left Left dirt: 0 Right dirt: 1	8 7 6 Move 4 right
Move right	1 2 3 4 5
Robot Right Left dirt: 0 Right dirt: 1	8 7 6 Move 8 up
Vaccuum: Right dirt 1 -> 0	1 2 3 8 4 5
Robot Right Left dirt: 0 Right dirt: 0	7 6 Move 7 left
4. depth-limited search Number of states evaluated=643 Number of states expanded=643	1 2 3 8 4 5 7 6
No solution found! 5. iterative-deepening search	Move 6 left
Number of states evaluated=2657 Number of states expanded=2656 Path length=11	1 2 3 8 4 5 7 6
1 2 3 4 5 6	Move 5 down
8 7 Move 8 left	1 2 3 8 4 7 6 5
1 2 3	Move 4 right
4 5 6 8 7	1 2 3 8 4
Move 7 left	7 6 5 6. A* search algorithm
1 2 3 4 5 6 8 7	Number of states evaluated=29 Number of states expanded=15 Path length=11
Move 6 down	1 2 3

4 5 6 8 7	1 2 3 8 4 7 6 5
Move 8 left	
1 2 3 4 5 6 8 7	Move 4 right 1 2 3 8 4 7 6 5
Move 7 left	7. See Below
1 2 3 4 5 6 8 7	a. Configuration 1, Breadth-first Search
Move 6 down 1 2 3 4 5 8 7 6	Number of states evaluated=53335 Number of states expanded=36835 Path length=21
Move 5 right 1 2 3	1 2 4 3 6 5 8 7
4 5 8 7 6	Move 2 right
Move 4 right	1 2 4 3 6 5 8 7
1 2 3 4 5 8 7 6	Move 1 right
Move 8 up	1 2 4 3 6 5 8 7
1 2 3 8 4 5 7 6	Move 4 up
Move 7 left	4 1 2 3 6 5 8 7
1 2 3 8 4 5 7 6	Move 5 up
Move 6 left	4 1 2 5 3 6 8 7
1 2 3 8 4 5 7 6	Move 8 left
Move 5 down	4 1 2 5 3 6 8 7

			8 7 6
			Move 4 right
4 1 5 3 8 7	6		1 2 3 4 5
 Move		 down	8 7 6
			Move 8 up
5 3			1 2 3
8 7 			8 4 5 7 6
		right 	Move 7 left
4 1 5			1 2 3
8 7			8 4 5
		 right	7 6
			Move 6 left
5	3		1 2 3
8 7 			8 4 5 7 6
Move		down	 Move 5 down
1			
4 5 8 7			1 2 3 8 4
 Move	 1	 left	7 6 5
1			Move 4 right
4 5	3		1 2 3
8 7 	6 		8 4 7 6 5
Move	2	left	b. Configuration 1, Iterative
1 2			Deepening Search
4 5 8 7			Number of states evaluated=594689
 Move		 au	Number of states
			expanded=594688 Path length=21
1 2 4 5			 1 2
8 7 			4 3 6
		right 	5 8 7
1 2	3		Move 2 right
4	5		

1	2																	
1 4 3 5 8																2 3		_
																6		
		right 	-										 Мс	. – V	 е	 1	le	f
1 4 3													 1	-		 2		_
5 8													4	Į.	5	3		
													8	1	7	6		
Move		up 											Mc	v	 е	2	le	f
4 1 3													1	_	 2			_
5 8	7															3		
Move	 5	 up											8	; - —	7 	6 		_
4 1													МС	V	e	3	up	,
5 3													1		2	3		_
	7													ļ.				
Move	 8	left											8	; 	7 	6		_
													МС	V	е	5	ri	g
4 1 5 3													 1	· —	 2	- - .		_
8													4	ļ		5		
Move													8	,	7	6		
													Mc	ν	 е	4	ri	g
4 1 5 3													1	_	 2	 3		_
8 7															4	5		
Move		down											8	; - —	7 	6		_
													МС	V	e	8	up	,
	2																	_
5 3 8 7	6															3 5		
													C			6		
		right 	:										 Mc	-			 le	_ _
4 1																		_
5	3															3		
8 7	6															5		
Move	- - -	 right	:													6 		_
4 1													МС	V	е	6	le	f
4 I 5													1	· — ·	 2	3		
8 7													8	3	4	5		
													7	,	6			
Move	4	down												-				_

Move 5 down	Move 7 left
1 2 3 8 4 7 6 5	4 1 2 5 3 6 8 7
Move 4 right	Move 6 down
1 2 3 8 4 7 6 5	4 1 2 5 3 8 7 6
c. Configuration 1, A* Search Number of states	Move 3 right
evaluated=646 Number of states expanded=373 Path length=21	4 1 2 5 3 8 7 6
1 2	Move 5 right
4 3 6 5 8 7 	4 1 2 5 3 8 7 6
Move 2 right	Move 4 down
1 2 4 3 6 5 8 7	1 2 4 5 3
Move 1 right	8 7 6
1 2	Move 1 left
4 3 6 5 8 7 	1 2 4 5 3 8 7 6
Move 4 up	Move 2 left
4 1 2 3 6 5 8 7	1 2 4 5 3 8 7 6
Move 5 up	
4 1 2 5 3 6 8 7	Move 3 up 1 2 3 4 5
Move 8 left	8 7 6
4 1 2	Move 5 right
5 3 6 8 7 	1 2 3 4 5 8 7 6

Move 4 right	4 3 5 8	7	
1 2 3 4 5			 right
8 7 6 	1 4 3		
Move 8 up	5 8		
1 2 3 8 4 5	Move	4	up
7 6 	4 1 3	6	
Move 7 left	5 8		
1 2 3 8 4 5	Move		up
7 6 	4 1 5 3		
Move 6 left	8	7 	
1 2 3 8 4 5			left
7 6 	4 1 5 3		
Move 5 down	8		
1 2 3 8 4			left
7 6 5 	4 1 5 3		
Move 4 right	8 7		
1 2 3 8 4			down
7 6 5 d. Configuration 1, Depth-limited	4 1 5 3		
Search (BFS)	8 7	6 	
Number of states evaluated=220837			right
Number of states expanded=220836	4 1 5	3	
Path length=21	8 7		
1 2 4 3 6			right
5 8 7	4 1 5	3	
Move 2 right	8 7		
1 2			down

1 2 4 5 3 8 7 6	1 2 3 8 4 7 6 5
Move 1 left	
1 2 4 5 3 8 7 6	Move 4 right 1 2 3 8 4 7 6 5
Move 2 left	e. Configuration 1, Depth-limited
1 2 4 5 3 8 7 6	Search (Double BFS) Number of states evaluated=595536
Move 3 up 1 2 3	Number of states expanded=595535 Path length=41
4 5 8 7 6 	1 2 4 3 6 5 8 7
Move 5 right	
1 2 3 4 5 8 7 6 	Move 6 up 1 2 6 4 3 5 8 7
Move 4 right	Move 6 down
1 2 3 4 5 8 7 6	1 2 4 3 6 5 8 7
Move 8 up	
1 2 3 8 4 5 7 6	Move 2 right 1 2 4 3 6
Move 7 left	5 8 7
1 2 3	Move 3 up
8 4 5 7 6	1 3 2 4 6
Move 6 left	5 8 7
1 2 3	Move 8 up
8 4 5 7 6 Move 5 down	1 3 2 4 8 6 5 7

4 8 6 8 2 3 5 6 1 4 7 3 4 2 1 7 6 1 1 5 6 4 7 3 4 2 1 7 6 1 1 5 6 4 7 3 8 2 1 7 6 1 1 5 6 4 7 3 8 2 1 1 7 6 1 1 1 1 7 6 1 1 1 1 1 1 1 1 1 1
4 8 6
5 7 3 5 6 1 4 7 1 4 7 Move 4 down
Move 4 down ——————— 1 3 2 —————— 8 6 8 5 2 4 5 7 3 6 —————— 1 4 7 Move 1 down —————— 3 2 —————— 1 8 6 8 5 2 4 5 7 3 4 6 —————— Move 7 left 3 2 ————— 1 8 6 8 5 2 4 5 7 3 4 6 ————— Move 7 left 3 2 ————— 1 8 6 8 5 2 4 5 7 3 4 6 ————— Move 6 dow 3 8 2 ————— 1 6 8 5 2 4 5 7 3 4 ————— Move 6 dow 3 8 2 ————— 1 5 6 8 5 4 7 3 4 2 ————— Move 5 rig 3 8 2 ————— 1 7 6 8 5 4 7 3 4 2 ————— 4 7 3 8 2 — 1 5 6 8 5 4 7 3 4 2 <tr< td=""></tr<>
1 3 2 8 6 8 5 2 4 5 7 Move 1 down
4 5 7
Move 1 down ——————— 3 2 ——————— 1 8 6 8 5 2 4 5 7 3 4 6 —————— 1 7 Move 3 left —————— 3 2 —————— 1 8 6 8 5 2 4 5 7 3 4 6 —————— Move 6 dow 3 8 2 —————— 1 6 4 8 5 2 4 5 7 3 4 —————— Move 6 dow 3 8 2 —————— 1 7 6 Move 2 dow 3 8 2 —————— 1 5 6 8 5 4 7 3 4 2 —————— Move 5 rig 3 8 2 —————— 1 5 6 8 5 4 7 3 4 2 ——————— 1 7 6 Move 1 down ——————
3 2
1 8 6
Move 3 left
1 8 6
4 5 7 3 4 6
Move 8 up
3 8 2
1 6 8 5 2 3 4
Move 5 up ——————— 3 8 2 —————— 1 5 6 8 5 4 7 3 4 2 ————— 1 7 6 Move 4 right —————— ————— Move 5 right 3 8 2 —————— 1 5 6 8 5 4 7 3 4 2 —————— 1 7 6 Move 1 down ——————
1 5 6 8 5 3 4 2 1 7 6 Move 4 right Move 5 right 8 5 4 7 3 4 2 1 7 6 Move 5 right 9 1 5 6 8 5 4 7 9 1 7 6 Move 1 down 9 1 7 6 Move 1 down
4 7 3 4 2 1 7 6 Move 4 right Move 5 right 3 8 2 3 8 5 8 5 4 7 3 4 2 1 7 6 Move 1 down
3 8 2
1 5 6 8 5 4 7 3 4 2 1 7 6 Move 1 down
1 7 6 Move 1 down
Move 1 down
Move 4 up
3 8 2
5 6 8 4 5 1 4 7 3 2
147 176
Move 3 down
8 2 Move 2 left
3 5 6 8 4 5

3 2 1 7		
		down
8 4 3 2 1 7	5	
		 right
8	 4	
3 2 1 7	5 6	
Move		up
8 2 3		
1 7		
Move	3	right
8 2		
3 1 7		
Move		down
2 8 3	5	
1 7 	6 	
Move	2	left
2	4	
8 3 1 7		
Move		up
2 3 8		
1 7		
MOVA	۰ <u>-</u> -	 right
	5	
1 7 	ь 	
Move	1	up

f. Configuration 2, Breadth-first	5 3 8 7		
Search Number of states	 Move		 right
evaluated=53335 Number of states expanded=36835 Path length=21	4 1 5 8 7	2 3 6	
1 2	Move	5	right
4 3 6 5 8 7	4 1 5	2	
Move 2 right	8 7 	6	
1 2 4 3 6			down
5 8 7 Move 1 right	1 4 5 8 7	3	
1 2		1	left
4 3 6 5 8 7	 1 4 5	2	
Move 4 up	8 7 		
4 1 2	Move	2	left
3 6 5 8 7	1 2 4 5		
Move 5 up	8 7 	6 	
4 1 2 5 3 6	Move	3 	up
8 7	1 2 4 5		
Move 8 left	8 7 	6 	
4 1 2 5 3 6	Move	5 	right
8 7	1 2 4		
Move 7 left	8 7 		
4 1 2	Move		right
5	1 2 4	3 5	
Move 6 down	8 7 		
4 1 2	Move	8 	up

1 2 3	Move	4	up
8 4 5 7 6	4 1		
	3	6	
Move 7 left	5 8 		
1 2 3 8 4 5	Move	5	up
7 6	4 1		
	5 3		
Move 6 left	8		
1 2 3 8 4 5	Move		
7 6	4 1		
	5 3		
Move 5 down	8		
1 2 3	Move	7	
8 4 7 6 5	4 1		
	5 3		
Move 4 right	8 7		
1 2 3	Move	6	down
8 4 7 6 5	 4 1		
g. Configuration 2, Iterative	5 3		
	8 7		
Deepening Search			
Number of states	Move	ა 	right
evaluated=594689 Number of states	4 1	2	
expanded=594688	5		
Path length=21	8 7		
1 2			right
4 3 6	4 1	2	
5 8 7 	5		
Move 2 right	8 7	6	
1 2	Move	4	down
4 3 6			
5 8 7	1 4 5		
Move 1 right	8 7		
Move 1 right			
1 2	Move		
4 3 6	1		
5 8 7	4 5		
	8 7		

Move 2 left	7 6 5 h. Configuration 2, A* Search
1 2 4 5 3 8 7 6	Number of states evaluated=646 Number of states expanded=373
Move 3 up	Path length=21
1 2 3 4 5 8 7 6	1 2 4 3 6 5 8 7
Move 5 right	Move 2 right
1 2 3 4 5 8 7 6	1 2 4 3 6 5 8 7
Move 4 right	Move 1 right
1 2 3 4 5 8 7 6	1 2 4 3 6 5 8 7
Move 8 up	Move 4 up
1 2 3 8 4 5 7 6	4 1 2 3 6 5 8 7
Move 7 left	Move 5 up
1 2 3 8 4 5 7 6	4 1 2 5 3 6 8 7
Move 6 left	Move 8 left
1 2 3 8 4 5 7 6	4 1 2 5 3 6 8 7
Move 5 down	Move 7 left
1 2 3 8 4 7 6 5	4 1 2 5 3 6 8 7
Move 4 right	Move 6 down
1 2 3 8 4	4 1 2 5 3

8 7 6	8 4 5 7 6
Move 3 right	
4 1 2	Move 7 left
5 3 8 7 6	1 2 3 8 4 5
Move 5 right	7 6
4 1 2	Move 6 left
5 3 8 7 6	1 2 3 8 4 5
Move 4 down	7 6
1 2	Move 5 down
4 5 3 8 7 6	1 2 3 8 4
 Move 1 left	7 6 5
 1 2	Move 4 right
4 5 3 8 7 6	1 2 3 8 4
	7 6 5
Move 2 left	i Configuration 2 Donth limited
Move 2 left 	i. Configuration 2, Depth-limited Search (IDS)
1 2 4 5 3	Search (IDS) Number of states
1 2 4 5 3 8 7 6	Search (IDS) Number of states evaluated=220837 Number of states
1 2 4 5 3 8 7 6 Move 3 up	Search (IDS) Number of states evaluated=220837
1 2 4 5 3 8 7 6 Move 3 up 1 2 3 4 5	Search (IDS) Number of states evaluated=220837 Number of states expanded=220836
1 2 4 5 3 8 7 6 Move 3 up 1 2 3 4 5 8 7 6	Search (IDS) Number of states evaluated=220837 Number of states expanded=220836 Path length=21
1 2 4 5 3 8 7 6 	Search (IDS) Number of states evaluated=220837 Number of states expanded=220836 Path length=21
1 2 4 5 3 8 7 6 Move 3 up 1 2 3 4 5 8 7 6 Move 5 right 1 2 3 4 5	Search (IDS) Number of states evaluated=220837 Number of states expanded=220836 Path length=21 1 2 4 3 6 5 8 7 Move 2 right
1 2 4 5 3 8 7 6 Move 3 up 1 2 3 4 5 8 7 6 Move 5 right 1 2 3	Search (IDS) Number of states evaluated=220837 Number of states expanded=220836 Path length=21
1 2 4 5 3 8 7 6 Move 3 up 1 2 3 4 5 8 7 6 Move 5 right 1 2 3 4 5 8 7 6 1 2 3 4 5 8 7 6 Move 4 right	Search (IDS) Number of states evaluated=220837 Number of states expanded=220836 Path length=21 1 2 4 3 6 5 8 7 Move 2 right 1 2 4 3 6 5 8 7
1 2 4 5 3 8 7 6 Move 3 up 1 2 3 4 5 8 7 6 Move 5 right 1 2 3 4 5 8 7 6 Move 4 right	Search (IDS) Number of states evaluated=220837 Number of states expanded=220836 Path length=21 1 2 4 3 6 5 8 7 Move 2 right 1 2 4 3 6 5 8 7 1 1 2 4 3 6 5 8 7 Move 1 right
1 2 4 5 3 8 7 6 Move 3 up 1 2 3 4 5 8 7 6 Move 5 right 1 2 3 4 5 8 7 6 1 2 3 4 5 8 7 6 1 2 3 4 5 8 7 6 1 2 3	Search (IDS) Number of states evaluated=220837 Number of states expanded=220836 Path length=21
1 2 4 5 3 8 7 6 Move 3 up 1 2 3 4 5 8 7 6 Move 5 right 1 2 3 4 5 8 7 6 Move 4 right 1 2 3 4 5 8 7 6	Search (IDS) Number of states evaluated=220837 Number of states expanded=220836 Path length=21 1 2 4 3 6 5 8 7 Move 2 right 1 2 4 3 6 5 8 7 1 2 4 3 6 5 8 7 1 2 4 3 6 5 8 7 1 2 4 3 6 5 8 7 1 2

	Morro	2	
. 2	Move		
3 6	1 2		
5 8 7	4 5		
 ove 5 up	8 7 	6 	
 4 1 2	Move	3	up
5 3 6	1 2	3	
8 7	4 5		
Move 8 left	8 7 		
4 1 2	Move	5	right
5 3 6	1 2	3	
8 7	4		
	8 7		
Move 7 left 	 Move		 right
4 1 2			
5 3 6	1 2		
8 7	4		
love 6 down	8 7 		
	Move		
4 1 2 5 3	1 2		
8 7 6	8 4		
	7		
Nove 3 right			
 4	Move		left
5 3	1 2		
8 7 6	8 4		
	7		
ove 5 right			
4 1 2	Move	6	⊥eft
5 3	1 2	3	
8 7 6	8 4		
	7 6		
ove 4 down			
1 2	Move		down
4 5 3	1 2		
3 7 6	8 4		
	7 6		
ove 1 left			
 1 2	Move	4 	right
4 5 3	1 2	3	
3 7 6	8		
	7 6	5	

j.	Conf	igura	ation 2, Depth-limited
	Searc	ch (I	Double IDS)
Nu	mber	of	states

Number of states evaluated=595536 Number of states expanded=595535 Path length=41

1 2

4 3 6 5 8 7

Move 6 up

1 2 6 4 3 5 8 7

Move 6 down

1 2 4 3 6 5 8 7

Move 2 right

1 2 4 3 6 5 8 7

Move 3 up

1 3 2 4 6 5 8 7

Move 8 up

1 3 2 4 8 6 5 7

Move 5 right

1 3 2 4 8 6 5 7

Move 4 down

1 3 2

8 6 4 5 7

3 2 1 8 6 4 5 7

Move 1 down

Move 3 left

3 2 1 8 6 4 5 7

Move 8 up

3 8 2 1 6 4 5 7

Move 5 up

3 8 2 1 5 6 4 7

Move 4 right

Move 1 down

3 8 2 5 6 1 4 7

Move 3 down

8 2 3 5 6 1 4 7

Move 8 left

8 2 3 5 6 1 4 7

Move 5 up

8 5	2						
3	6						
1 4	7 				2 7		
Move	4	up	-				up
8 5			-				
3 4 1					2		
	. <u>.</u> .				7		
Move	7 	left 	 Ma	 7C	 /е	- - -	rig
8 5							
3 4 1 7	6		•	3	2		
		down	_	1	7		
8 5			Mo	7	<i>i</i> e	8	dow
3 4			- -		2	4	
1 7	6				3		
Move	2	down	 	l 	7 	6 	
8 5			Мо	7	<i>r</i> e	2	lef
3 4			 :	 2		4	
1 7	6				3		
Move	 5	 right		l 	7 	6	
			Мо	7	<i>z</i> e	3	up
8 3 4				 2	 3	4	
1 7			1	8		5	
 Move	 4	up		l 	7	6	
			Mo	7	<i>r</i> e	8	rig
8 4 3	5 2			 2	 3	4	
1 7	6				8	5	
Move	2	left	: 	L 	7	6 	
			Mo	7	<i>r</i> e	1	up
8 4 3 2			- -	 2	 3	 4	
1 7					8	5	
		down			7	6	
			—- Mo	7	 7е	7	lef
8 4							
3 2 1 7					3 8		
				7	J	6	
Move	4	right					

Mov	е	6	left
1	 3 8 6	4 5	
Mov	 е		down
2	3	4	
	8 6	5	
Mov	 е	4	down
1 7		4 5	
Mov			right
2 1	8	3 4 5	
Mov	 е	2	right
1	2 8 6		
Mov		1	up
1	2	3 4	
		5	
Mov	е е	8	left
	2	3 4 5	

The solution matches our expectations because when the number of paths from BFS or IDS means there must be a solution out there can be find for depth-limited search which totally make sense. Also, by restricting the

depth of the solution can reduce the number of state evaluation because the algorithm will not generate more path since it has been restricted and it will only be evaluated from existing states. Compare to BFS and IDS, once the path is incorrect, the IDS will also search from all the wrong path no matter the path is doable or not and BFS will go through all states parallelly which is a better solution to find the solution. However, A* performed much better for all of them because it will evaluate the current state and choose the best path.

8. non-trivial board configuration

BFS Number of states evaluated=16554 Number of states expanded=10671 Path length=18

IDS Number of states evaluated=135184 Number of states expanded=135183 Path length=18

Depth-limit search (BFS) Number of states evaluated=30843 Number of states expanded=30842 Path length=18

Depth-limit search (Double BFS) Number of states evaluated=13619 Number of states expanded=13618

Path length=34

A* (Total Manhattan distance heuristic) Number of states evaluated=281 Number of states expanded=156 Path length=18

A* (Misplaced tiles heuristic) Number of states evaluated=1358 Number of states expanded=771 Path length=18

A* (Simplest heuristic (h(n)=0))
Number of states
evaluated=14609
Number of states
expanded=9544
Path length=18

As we discussed before, A* algorithms have advantages to solve specific problems like 8-puzzle, however, the difference between number of states is occurred by implementations. In conclusion, A* will "never overestimates actual distance to goal" which makes it performed better compared to BFS, IDS (even with the simplest heuristic, the performance is close to BFS which is the best case in uninformed search). In this 8-puzzle problem, we need to misplace some tile to reach the final goal which makes the number of evaluation larger than Manhattan distance which matches our expectations.